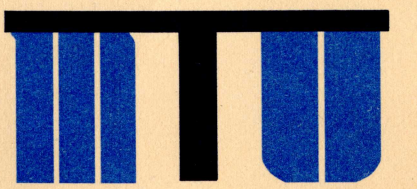
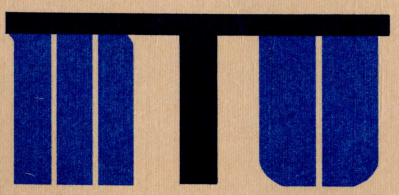
MTU-130

The Personal Computer Of Professionals





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(919) 833-1458

Who Is Micro Technology Unlimited?

Where MTU Operates Its Business

Micro Technology Unlimited (MTU) was founded in March, 1977 to bring high technology products and technical information to the market in easy to use form. Our total history includes use of many of the commonly available microprocessors starting in 1972 with the 8008 microprocessor.

MTU is our second company. Our first, Technology Unlimited Inc. (TUI), was sold because the product line was more valuable to other companies and was too big for a small company to market. That product is now the A. B. Dick Magna S/L word processor. It is a full page CRT (we patented the design), 16 bit microprocessor controlled multi-tasking, multi-terminal system.

At MTU our direction has been the design and sale of peripheral products based on the 6502 microprocessor. The price and performance of this processor are excellent while its technical features, both software and hardware, allow us to build sophisticated products at very competitive prices. The principals of the company are David B. Cox, President and Howard (Hal) A. Chamberlin Jr. V. P. Engineering. These men have been cooperating together in a synergistic manner for over 16 years. The company is wholly owned by the principals. Anyone needing financial or other operating information about MTU should contact Mr. Cox.

User Referral Marketing

Because of the knowledge of customers using the MTU-130 system, we have initiated a unique marketing plan. We know that our customers greatly enjoy demonstrating and talking about their system to others. This "word of mouth" promotion is important to us and we would like to involve you, our customers, in receiving benefits from recommending the MTU-130 system.

Basically, this plan states that any MTU-130 owner can send qualified potential customers names to MTU. If a purchase is made by that customer within 12 months, the user who sent in the name will receive a credit. This credit may be taken as a cash payment or accumulated during a 12 month period as credit toward purchase of MTU software and/or hardware. If accumulated credits exceed the price of the desired MTU product, there is a credit balance remaining for future "purchases". For your own benefit, contact us for the full details.

Custom Requirements?

MTU has a strong history of custom support. We can quickly turn a request for a solution into the needed hardware and/or software. We are always ready to discuss needs with ANY customer and propose how we can solve a particular problem. We are especially interested when you find a specific application of the '130 in solving a problem for your industry. Those who try us, find us quite resourceful in coming up with workable arrangements. Give us a try!

Application for Dealership

We are interested in working with any dealer who is dedicated to customer support, learning and understanding the products they sell, and working closely with the MTU factory and existing users for feedback. Due to the functional power of the MTU-130 system, it has been found that dealers with strong software support are best suited to market this system. If you feel that the MTU-130 fits into your operation, please contact us for a dealer package. Inquiries from consultants are also welcome.

Warranty

MTU manufactured products are warranted for 6 months from date of shipment from the factory to be free from defective parts and workmanship (CRT monitors, disk drives and printers for 45 days). Any other damages including but not limited to: misuse, misconnection to the system, abuse, fire, flood, or other acts of God are not covered by this warranty. No other statements than these printed specifications are made or implied. Liability of MTU is limited to repair or replacement of faulty units and does not extend beyond the purchase price of the units.

Additional Information

For technical information beyond the product descriptions in this catalog, we suggest purchase of the manual. Manuals are **NOT** included in the products. They are priced separately to facilitate easier manual purchase prior to the purchase of the desired product. If the manual does not answer a specific question or if you feel that your question is unlikely to be answered by the manual, please contact us directly (919) 833-1458.

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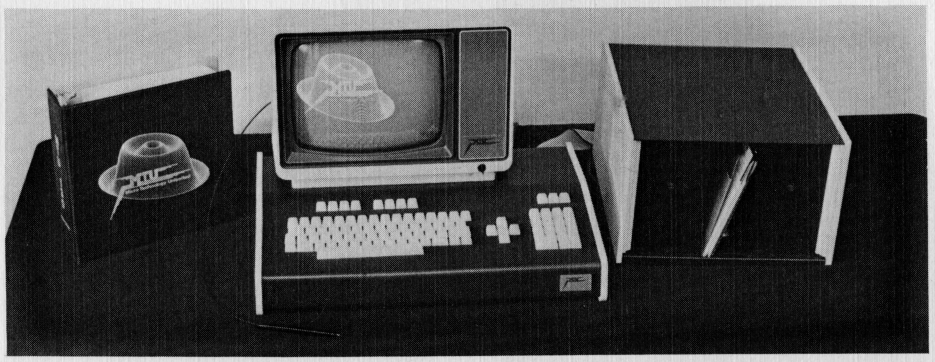
INTRODUCING THE MTU-130 COMPUTER



The machine that will change your view of desktop computers.

Until now...

... If you demanded advanced, device-independent operating system software...

... If you needed fast, ultra reliable handling of megabyte size disk files...

... If you needed interrupt processing during disk accesses...

... If you wanted advanced high resolution graphics...

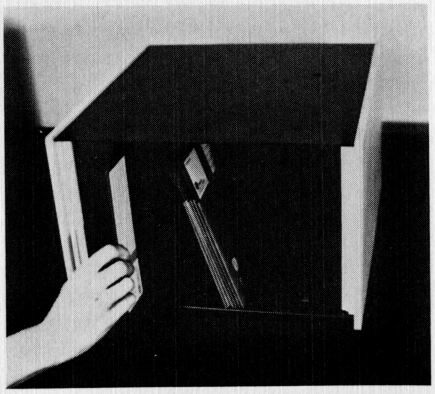
... If you desired human-interface features such as light pen, digitized speech, programmable function keys with displayed legends...

you either bought an expensive minicomputer plus add-ons, or you did without. Now, the MTU-130 professional computer is here.

MTU has established a new standard of excellence in power and flexibility in a desktop computer. This system is designed as a tool for the discriminating individual who needs something more than a microcomputer system designed to meet mass market needs. With this system the limiting factor is the user's creative abilities, not system restrictions. This means that you will not quickly exceed the system facilities, but will find room to grow, learn and expand into.

The MTU-130 features are expertly designed, following current mainframe and minicomputer industry standards. The '130 has been given an operating system with true data/device independence, RAM based software, user extensibility, standard software development tools, and professional quality construction providing errorless operation and long term reliability. Through exacting design, the standard human interface devices go beyond what has been economically available up to now, thus reducing learning time for the user to become productive. The '130 is a logical extension from mainframes and minicomputers into a personal work station.

In a professional system, mass storage is one of the most critical values. It is important that store/recall operations execute rapidly, files be removable from the system, information backup be fast and accurate, and the cost kept to a reasonable level. To meet these needs 8" floppy disk operation was chosen as the standard. The '130 design incorporates the most advanced disk electronic techniques including Direct Memory Access (DMA) to the on-board memory. Disk operations are performed without interrupts or processor involvement allowing the processor to service interrupts during disk accesses. In addition, the data separator circuit exceeds present day standards for accuracy of data storage and recall. This is accomplished even while running at 20,000 bytes per second sustained transfers. Double density recording is standard with automatic sensing of whether a single or double sided diskette is being used.



Floppy Disk Based

A minimum of knowledge is required to control this disk operated computer. System operations are transparent, you need only to save and retrieve the work you want. Stored file formats have **ABSOLUTELY** no restrictions or forbidden code usage since they are simply continuous strings of bytes, making it simple for you to understand and use. Files may be manipulated in any way, with any technique that best suits the application. All operations are designed to prevent destruction of files, unless intentional. With the same commands, you can type to the CRT, to a disk file, or to the printer by specifying a filename or a device destination letter. When a program is to be retrieved from disk and executed, simply type its filename and press Return and it is ready before you are. When a file is to be saved, the amount of disk space needed is allocated automatically. This is just a small sample of the transparent operation given you to control this computer.

32,000 Characters Load in 2.6 Seconds

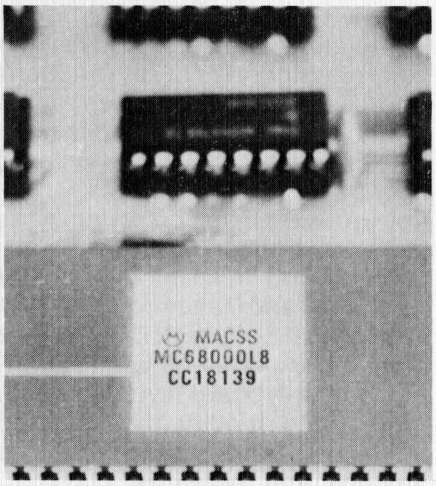
Another element of the '130 design philosophy is that all software is loaded into read/write memory from disk, not stored in Read Only Memories. This means that at any time, only those programs you are using are occupying the valuable system memory resources. Because of the design, waiting time is a minimum — 32,000 characters load from disk to memory in 2.6 seconds.

The system contains a small bootstrap loader ROM which at power-up time or RESET, automatically loads any selected application programs from disk into memory along with the CODOS operating system. CODOS is the software interface between you and the hardware which executes your commands. It is a proven system designed specifically for professional computers, to be used by both the novice and advanced user. With CODOS, the user need never create any "scratch" areas or buffers for file loading or storing. All necessary functions for manipulating disk files are done transparently while automatically maintaining a file directory.

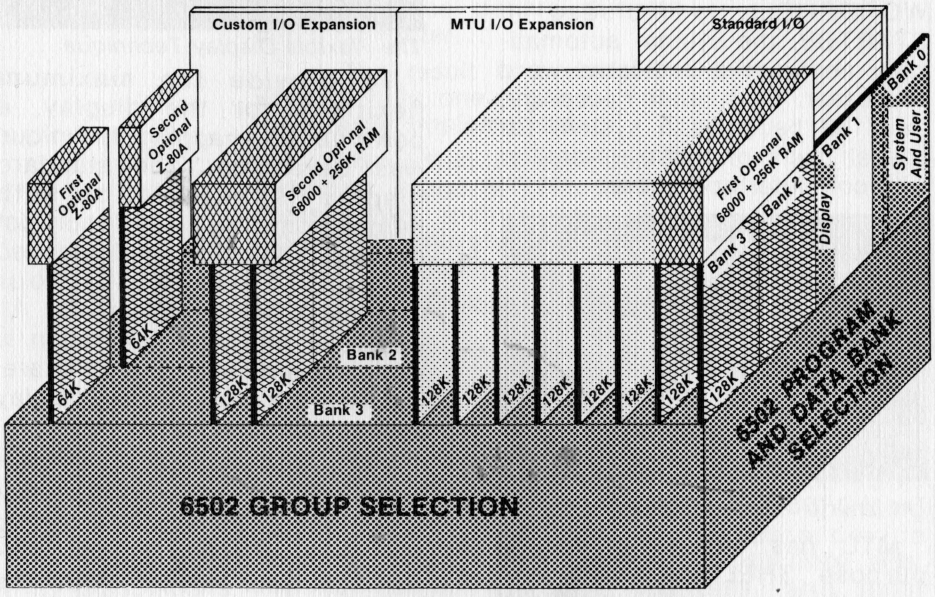
The Floppy drives are housed in a case which includes a convenient storage area for up to 20 diskettes between the 2 drives. All '130 systems contain at least one 8" double density, double sided floppy disk drive with 1 MegaByte of FORMATTED storage. Hard disk is optional.

Expansion Provided, Not Just Planned.

At MTU, our belief is that most applications can be done quite easily with an 8 bit 6502 processor IF it is given the necessary support to utilize its inherent power. However, with the advance of technology, many people today are concerned about their computer being "not as powerful" as newer designs. The '130 has been designed to be efficiently usable for many years and upward expandable when more power is needed. Introduction of the DATAMOVER board with its 68000 processor completely integrated into the system is firm proof that the base '130 system is expandable to more powerful operation when needed.



Today, with the uses that microcomputers are being put to, the need exists for greater than 64K bytes of memory. In order to provide clean memory expansion in the '130, provision was made for the base 6502 processor to address beyond 64K bytes. This is accomplished with a sophisticated method where program and data memory may be separated. This allows a program to "reach" up to 128K bytes dynamically without constantly referring to bank-switch registers. The method is simple — the 6502's indirect addressing modes automatically refer to the current "data bank" while other modes refer to the program bank.



Standard Group, Program Bank, and Data Bank Selection.

Standard I/O

Optional (currently available)

Optional

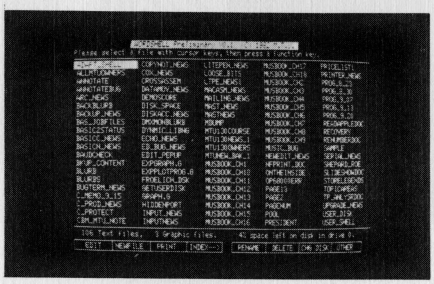
The diagram above shows how memory is addressed and shared between the 6502 and optional expansion memory and processor boards. Note that the optional boards and the 6502 share up to 128K bytes of RAM at a time, with the actual blocks determined by the 6502. A total of up to 1.58 Megabytes of RAM can be available with future expansion. A write protect feature is incorporated in the 6502 bank 0 memory to prevent overwriting of the RAM based system programs. For programmers who care to know, you will be pleased to find that we have left you 176 bytes free ($00-$AF) in the 6502 page 0.

The optional Z-80A or 68000 processor boards are designed with 2-port memories which share the 6502 expanded addresses. This allows the 6502 to become a dedicated I/O processor for the other processors when they are called into operation.

Simultaneous computing on all processors is possible through the use of bidirectional interrupts between them to synchronize operations. You can have the standard 6502 with an optional 4 MHz Z-80A, or an optional 8 MHz 68000 or all three, all processing simultaneously! The choice of processing power and software is yours.

The MTU-130 is designed with internal expansion, even though many features are standard that are additional cost or even unavailable on other systems. The built-in expansion card file can accept 3 additional large 11" boards. The back connector panel contains metal cover plates to receive custom mounted connectors, the power supply is sufficient to power full expansion, and the internal cooling fan provides cooling for full expansion. As your needs change, simply expand instead of replacing your MTU-130.

When the '130 is turned on, if the diskette in drive 0 contains a disk file, named STARTUP, control is passed from CODOS to this file. STARTUP can contain anything including CODOS commands or multiple application programs, turning the '130 into a dedicated application system. For example, if WORDSHELL is included in STARTUP, the system automatically becomes a dedicated word processor. Thus, when necessary, the '130 becomes a system for casual users or those unfamiliar with computer operations.



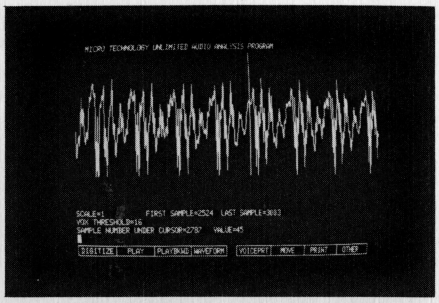
The WORDSHELL Display Format

MTU has created a general purpose SHELL program and made the source code available to you. It is a modifiable interface program that shows your selected and sorted files for the user's easy choice, using both menu and function key operations. With this code, you can create an immediate use interface for users.

Under specialized disk format control, a disk data transfer rate of 37.5K bytes per second can be sustained. The optional SLIDE-SHOW program uses this format to present 2.5 full screen images per second from disk to the display!

The special high speed disk transfer can be sustained for an indefinite time by swapping diskettes in the standard dual disk drives. This gives the system an incredible ability to perform heretofore ultra-expensive experimental operations in fields such as delayed playback music or sound output, high-speed data acquisition, speech processing, etc. With the soon to be announced DIGISOUND-16 hardware board this becomes possible on the '130.

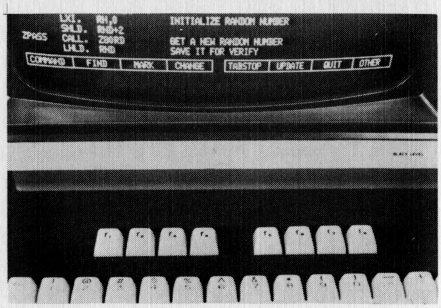
The optional DISKEX utility program uses special control to read and write other diskette formats including IBM, CP/M, and FLEX. This permits transfer of text and/or data to other systems not running under CODOS.



The Flexible Display Technique

To provide the maximum flexibility for the display, a powerful bit mapping technique was developed. The standard display is capable of both monochrome high resolution dot graphics (480X256) and reduced resolution (240X256) four brightness level gray scale. All character and line generation is done completely in software, creating the most flexible display system possible.

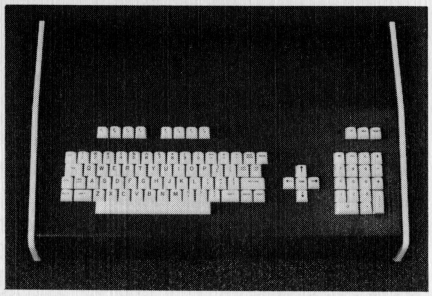
The primary advantage of a bit mapped display is that it allows text and graphics to be mixed for the maximum effective communication of your ideas. With the standard graphics software this is simple and fast; horizontal lines draw at 100,000 dots/second and any diagonal lines at over 18,000 dots/second. With the standard CODOS Text Driver the display turns into 24 lines of 80 characters with upper/lower case and descenders — when you need it.



The current titles of the 8 function keys are shown on the legend line at the bottom of the display. These legends can change quickly as menu selections are made, keeping in front of the user those selections which can currently be chosen.

Using the standard FONTEDIT program and the light pen, you can completely modify the standard full ASCII character set. Using the standard MTU-EDITOR, you can embed any ASCII code into text files AND see it on the display.

With the optional DATAMOVER board, you may obtain a dot graphic resolution of **1536 X 1024** using the standard display as a 256X480 window. The full window can be moved to a new position in the image in one fifth of a second, or show five windows per second for simulation. With this technique you add an ultra resolution capability that would cost thousands of dollars on other systems — if even available. Again proof of the MTU-130 power to outperform the norm.



Human Hand Engineering

The system keyboard is designed for maximum flexibility and usability. Like the display character generation, the keyswitch encoding is done completely in software. This allows total reassignment of key functions and use of different encoding methods to match the application. The standard CODOS Keyboard Driver subroutine operates with 2-key rollover, no buffering, and polled operation. But, for example, WORDPIC uses interrupt operation and N-key rollover with type-ahead buffering. Did you ever want to experiment with a non-standard keyboard layout? All you need is to modify the standard keyboard driver, rearrange the keytops, and there it is!

Valuable Protection

To provide protection for valuable software, every '130 has a unique factory-installed serial number readable under program control. Only the original programmer needs to know how his program checks this number. A program that does not check serial numbers is just like all other programs on other computer systems. In addition to the serial number, a group number can be established and installed for multi-machine installations to allow easy diskette interchange if the protection method is modified for group number checking.

Communications And I/O

Naturally you want to exchange data and text files with your computing associates. The standard RS-232 serial communications port with AUTOTERM program lets the MTU-130 function as a terminal to another computer, or with an optional modem, dial up other computers or database services such as SOURCE and MICRONET. You can both send and receive files, even recording the complete dialog on disk for later recall. This can be done interactively or unattended at night when rates are low — you select when!

In addition to the standard RS-232 port, the MTU-130 contains: an audio cassette tape read/write port, two 8 bit parallel ports, an audio 8 bit D/A converter port with built-in 3x5" speaker and amplifier with volume control for sound and speech creation or reproduction, and a fiber optic light pen which reads 30 to 60 (x,y) coordinates per second from the CRT. All ports are available at individual connectors on the rear panel.

When it comes to expansion, the MTU-130 performs again. With the standard printer text and graphic screen dump driver software, it can drive virtually any of the popular printers. It can handle up to 4 disk drives or install the optional MULTIDISK controller board which allows mixing of floppy drives and hard disks. For additional Serial, Parallel, 12 bit A/D and D/A, IEEE-488 and realtime clock, just add in the optional MULTI-O board. The '130 is designed fully usable, but expandable when you need to with those special functions that not everyone requires.

The remainder of this catalog gives you the detailed information you need to make your decision about the MTU-130. It is not for everybody, but if you are not like everybody, continue researching this exceptional tool. If there are any questions remaining when you are finished, please feel free to call MTU directly — or your friend who owns an MTU-130. We are dedicated to your needs and appreciate your comments.

If you'd like a chance to review the MTU-130's features in detail, why not call or write us today, and see for yourself what all the excitement is about.

The Reviews Are In — So Is The MTU-130!

"Micro Technology Unlimited of Raleigh, North Carolina has announced the development of a 'top of the line' general purpose micro computer...

"... The result is a computer which is fully, one might even say luxuriously, implemented...

"... Also, when the computer is turned on, it says 'MTU Model 130. Please enter today's date.' The 'voice' is entirely digital and sounds remarkably human..."

— COMPUTE Magazine

"My MTU-130 was a very pleasant surprise, after becoming acquainted with all the features. The hardware quality is excellent, and the amount and quality of software included was far beyond my expectations. The value of the software must be close to $1,000 of extras on other systems.

"I am very pleased with the speed performance of CODOS; the mini-computer systems I have used in the past would be left in the dust by most CODOS functions.

"Frankly I was amazed that I encountered virtually no hang-ups in the first month's use."

— Joseph A. Carr
Carr Consulting
Canada

"When computer professionals get more excited over a new computer than the kids next door, you know the machine has to be impressive.

"The computer that is receiving this kind of attention at my house could easily be the most powerful and versatile microcomputer yet offered for personal, professional, or small business use. It is the MTU-130, a superb new computer.

"... The computer offers what is probably the most advanced disk operating system available for microcomputers...

"... The system is so simple and flexible that it was actually hard for me to accept the first time..."

— Carl Strobel
Creative Computing Magazine
Equipment Evaluation

"I have found micro-computers lacking in several important aspects. I expect computer systems to include real operating systems, some data/device independence, productivity aids, readable manuals, and most importantly, professional quality construction.

"... It seemed that the micro world was slowly re-inventing all the wheels that were previously created in the main-frame world. I really thought that I would have to wait a few more years for the micro world to catch up to the rest of the computer industry. I was wrong! The MTU-130 is a logical extention of (mainframe and supermini) industry wide developments...

"... I am associated with McMaster Inc. where one of your MTU-130 machines has been running continuously for the last six months. During this period, the MTU-130 never failed. Not a single electronic or software error was registered on the main board, keyboard, or disk units. In fact, we have not even had a single disk read error!"

— Robert C. Levine
McMaster's Inc.
New Jersey

"This system is so elegant that we predict CODOS will become the standard 6502 operating system."

— Jack Brown
Saturn Softnews

MTU-130 STANDARD HARDWARE DESCRIPTIONS

The basic hardware machine functions have been described earlier, but are summarized here for completeness. The MTU-130-2D is the standard system that will be discussed.

There are 3 modules included in the MTU-130-2D system: the CRT DISPLAY MODULE, CPU MODULE, and the FLOPPY DISK MODULE. Two 8" diskettes are included with the system, one containing the standard distribution software and the second containing a wealth of demonstrations and some games to allow immediate use and appreciation of your new system. The 780 page MTU-130 manual is priced separately to allow you to purchase or receive it early. When an MTU-130 system is ordered from us, we ship the manual immediately so you will be ready when your system arrives.

Floppy Disk Module

* Two QUME 8" double density, double sided floppy disk drives each with 1 MegaByte formatted storage (These are fast and one of the most reliable drives sold.)
* Floppy disk cable to CPU module
* Power supply and cables for 2 drives
* Built-in AC power line cord
* Internal 3" cooling fan
* Painted metal covers
* Storage area for 20 floppy diskettes

The MTU-130-1D system is identical to the MTU-130-2D except it contains only one QUME floppy disk drive and a metal facia plate in the position of the second. The MTU-130-4D system is also identical except it contains a second Floppy Disk module for a total of 4 QUME floppy disk drives.

CRT Display Module

12" diagonal measurement display
P-31 green phosphor
Video signal cable

CPU Module

Keyboard
62 key main array
8 programmable function keys
18 key calculator/function array
5 key cursor "+" array
3 keys-Interrupt, Warm/Cold Reset
Power on LED indicator

Power Supply
Spike/noise suppression filter
Removable line cord
Primary power fuse
On/off rocker switch
Power transformer
Rectifier/regulator circuit card

Dress Covers
Connector mounting back surface
Painted left side with 3x5" speaker
Painted right side with 3" fan
Painted top metal cover
Painted base and back metal cover
Fiber optic light pen amplifier
Fiber optic wand with connector

Electronic Card File
Card cage for mounting 5 PC boards
Backplane with gold finger connectors
Processor card 6502, 64K RAM, Video, I/O
Floppy disk controller with 16K RAM

Standard Input And Output Ports

The Input and Output functions provided standard on each MTU-130 include connectors mounted on the rear panel. The keyboard, CRT, and disks are integrally connected, thus none of the standard I/O ports are used for these system interconnections. The optional MULTI-O board provides non-standard I/O capabilities.

Fiber Optic Light Pen: This is used generally as a graphic input or screen digitizer. It allows the operator to quickly make menu or other displayed option selections and draw and shade images. It has a response speed of 30 to 60 points per second, with single dot resolution (±2 dots uncertainty). The X,Y coordinates and a "hit" flag indication can easily be read by MTU-BASIC Libraries, MTU-FORTH, MTU-C and machine language programs for use in applications. The low cost handheld wand is detachable by a connector on the rear panel for replacement or protection when moving the system.

8 Bit Parallel: 2 ports are provided including a 36 pin connector. Each bit can be independently software selected for either input or output. Four handshake lines are provided including interrupt operation. For convenience, +5V and +12V regulated power and a system RESET signal are provided for use by peripherals attached to this connector.

RS-232 Serial: The single port is capable of simultaneous transmit and receive (full duplex). All normal baud rates from 50 to 19,200 are software selectable. The port allows interrupt operation and includes full control signals to operate with an optional auto-answer auto-dial modem. All signals are available at a standard 25 pin D-type connector.

Audio Output: This port consists of an 8 bit Digital to Analog Converter, a sharp cutoff 6 pole lowpass filter and a 1 watt audio amplifier. The output is connected to a built-in 3x5" speaker with volume control and to an external phone jack which disconnects the speaker when used. Standard software allows using this port for creating digital synthesized music and playback of predigitized human voice stored as sound files on disk. The optional DIGISOUND-8 package allows storing and editing your own sounds, words or phrases for storage and use under program control.

Cassette Port: This port allows reading and writing of cassette tapes for transfer of information between the MTU-130 and tape-based computers. The cassette circuitry is capable of using most audio cassette formats known by MTU to be in general use. Appropriate software drivers are required, with APPLE and AIM-65 tape drivers presently available on user group diskettes.

Video Output: The display signal is available at a rear panel RCA phono connector. The signal is standard composite video and is fully compatible with all high-quality CCTV monitors such as used in classrooms. The video signal can be presented to you and others simultaneously.

MTU-130 STANDARD SOFTWARE DESCRIPTIONS

MTU-130 standard software supplied at no additional cost is described in this section. Optional software and hardware are described following this section.

Software Protection Details

One of the biggest problems facing the micro-computer user today is that software companies and programmers must protect their work. Various methods have been tried such as retrofit serial numbers, and copy protected diskettes, but these are a handicap for both users and programmers. The approach MTU has taken is full factory support for protection.

Every MTU-130 has a unique factory installed serial number readable under program control. Embedding checking of this number in a program will prevent the program from running on any other '130 system. The method of checking is completely up to the original programmer, and only he needs to know how the checking is done. If serial number checking is not performed, the program will run on all '130 systems. The protection option is up to the program author.

Besides the unique serial number, two additional group numbers can be established and installed in each system for multi-machine installations to allow interchange of all diskettes between the various systems.

MTU has a development package for software houses which includes suggestions and provides a program for use in making production diskettes containing protected software.

CODOS the 1980's Vintage Operating System

One of the most important parts of any computer is its operating system. CP/M was the rage of the 70s, because it was the first widely available system. But in the 1980s, users are more sophisticated and are demanding more usable and flexible operating systems such as those they have come to know on minicomputers and mainframes. CODOS (Channel-Oriented Disk Operating System) answers these demands, without requiring vast amounts of the system memory or sacrificing speed. CODOS is very easy to use by both end-users and programmers alike, and offers speed and flexibility that has to be used to be fully appreciated.

CODOS is an overlay system, meaning that only a portion need be in memory at any time. The portion which allows programs to run is a fixed "kernel" which is always in memory. When a non-runtime command or error message is needed and is not found in memory, the system automatically retrieves it from disk into one of the overlay memory buffers. Any system or user error is shown on the CRT as an error number followed by a short, descriptive English message.

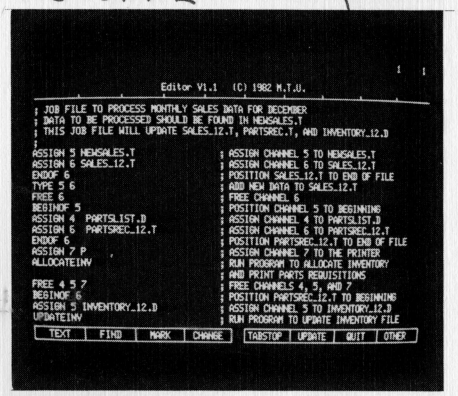
CODOS provides true device-independent I-O through the use of dynamically re-assignable channels. These channels may be assigned to disk files, the CRT, the Keyboard or other input or output devices and operations may then take place directly between the assigned channels.

A CODOS file, like a UNIX file, is viewed simply as a large array of bytes, readable or writeable at any location using a record of any length. A file appears the same as any other device such as a printer. Files are dynamically allocated - as new material is written to a file, the disk space used by that file is automatically expanded as required. Application programs can access files using random, sequential, or any other access method.

CODOS includes support for bank switching which allows reading or writing programs or data into any single or multiple memory banks automatically from the disk.

You use CODOS directly in four ways; (1) USER COMMANDS which are written to perform specific applications, (2) JOB FILES which are command "batch programs" written to perform a fixed sequence of operations, (3) the SYSTEM MONITOR which allows direct keyboard control of the computer, and (4) UTILITY programs for transfer of information among files and devices.

JOBFILE ⊂ use of Channels


Editor V1.1 (C) 1982 M.T.U.
; JOB FILE TO PROCESS MONTHLY SALES DATA FOR DECEMBER
; DATA TO BE PROCESSED SHOULD BE FOUND IN NEWSALES.T
; THIS JOB FILE WILL UPDATE SALES_12.T, PARTSREC.T, AND INVENTORY_12.D
;
ASSIGN 5 NEWSALES.T
ASSIGN 6 SALES_12.T
ENDOF 6
TYPE 5 6
FREE 6
BEGINOF 5
ASSIGN 4 PARTSLIST.D
ASSIGN 6 PARTSREC_12.T
ENDOF 6
ASSIGN 7 P
ALLOCATEINV
FREE 4 5 7
BEGINOF 6
ASSIGN 5 INVENTORY_12.D
UPDATEINV
; ASSIGN CHANNEL 5 TO NEWSALES.T
; ASSIGN CHANNEL 6 TO SALES_12.T
; POSITION SALES_12.T TO END OF FILE
; ADD NEW DATA TO SALES_12.T
; FREE CHANNEL 6
; POSITION CHANNEL 5 TO BEGINNING
; ASSIGN CHANNEL 4 TO PARTSLIST.D
; ASSIGN CHANNEL 6 TO PARTSREC_12.T
; POSITION PARTSREC_12.T TO END OF FILE
; ASSIGN CHANNEL 7 TO THE PRINTER
; RUN PROGRAM TO ALLOCATE INVENTORY
; AND PRINT PARTS REQUISITIONS
; FREE CHANNELS 4, 5, AND 7
; POSITION PARTSREC_12.T TO BEGINNING
; ASSIGN CHANNEL 5 TO INVENTORY_12.D
; RUN PROGRAM TO UPDATE INVENTORY FILE
TEXT
FIND
MARK
CHANGE
TABSTOP
UPDATE
QUIT
OTHER

(1) **USER COMMANDS** are assembled or compiled program files stored on disk in a form ready to run in memory. Information can be passed to these programs when they are entered from CODOS. For example, the file SPEAK is a standard '130 program. Typing SPEAK POSITIVE1 followed by Carriage Return will load the digitized speech file POSITIVE1. The net effect is that the speech file will be output through the Audio port, clearly reproducing its recorded message.

(2) A **JOB FILE** is executed by a "DO" MONITOR command. The JOB FILE contains instructions that will be executed just as if they had been typed on the keyboard. The STARTUP job file on any diskette will automatically be executed by CODOS at power-up time or when a cold RESET is performed. Use of this facility can turn the system into a turnkey machine, with the user never seeing CODOS or using its commands. Thus, you do not need to know programming to create your own specialized environments. The JOB FILE and USER COMMAND features allow any level of extension of the functions of CODOS that you need.

(3) You will interact with the **SYSTEM MONITOR** unless you are running an application or SHELL interface program. Monitor commands are most often used to start the execution of programs, examine system attributes (such as the names of files present on a disk), or alter the system (such as adding a new program to a disk). As an example, look at the command TYPE. Entering TYPE REPORT3 will display the contents of the file REPORT3 on the screen, TYPE REPORT3 P will make a copy on the printer and TYPE REPORT3 REPORT3B will create a duplicate copy of the file on the same drive with the new name. All Monitor commands can be read from JOB FILES. Other Monitor commands are:

Open - Open the specified disk for use
Close - Terminate disk operations
Date - Set the date
Files - Display names of files on disk
Delete - Delete a disk file
Disk - Display number of files and unused space remaining on each drive
Drive - Specify the default drive number
Do - Execute a list of Monitor or user commands from a "batch" job file
Go - Begin execution of program
Get - Load program or memory images
Getloc - Display file multiple load-addresses and entry point
Save - Save program or memory images
Next - Resume halted program execution
Rename - Change the name of a file
Type - Show, print, copy, or append file
Assign - Display/alter assigned channels
Beginof - position file pointer to start of file
Endof - Position file pointer to end of file
Free - Release channel, if assigned
Lock - Write-protect the specified file
Unlock - Disable write-protect on a file
BP - Breakpoint command for debugging
Boot - Reload CODOS
Compare - Compare two blocks of memory
Copy - Copy memory block
Dump - Display memory in hex & ASCII
Fill - Fill memory block with a constant
Hunt - Search for byte string in memory
MSG - Send a message to a channel
Onkey - Define function key legend and substitution string
Reg - Display or change CPU registers
Set - Set memory to specified value(s)
SVC - Enable/disable Supervisor Calls
Protect - Enable memory write-protect
Unprotect - Disable memory write-protect

(4) **UTILITIES** differ very little from SYSTEM MONITOR commands from the user's viewpoint. They are invoked from CODOS by merely typing the name followed by any required or optional arguments. As with MONITOR commands, they can be called from a JOB FILE in a batch operation. However, Utilities do have the following distinctions: (1) all Utility names appear in the disk directory just as any USER command, and (2) Utilities do not execute in System RAM, but elsewhere in memory. The following UTILITY programs are supplied standard with CODOS.

BACKUP - Permits fast and easy backups of CODOS diskettes. No previous formatting is required. A 1 Megabyte diskette is copied in two minutes. This Utility allows you to copy ANY MTU-130 diskette. Programs which are protected run only on the machine with the specified user number, but users have the right to back them up.

BROWSE - Permits fast and efficient random scanning of large CODOS text files without using the MTU-EDITOR. An in-memory index to each line of the file is made for INSTANT random access. Once the index is quickly built, the user can display 20 lines starting at any line in the file by typing the desired line number. If a signed (+ or −) number is entered, BROWSE will skip foward or backward through the file using the specified displacement. If a character string in quotes is entered, BROWSE will search for that string starting at the current line number.

COPYF - Copy whole files in a multi-drive system. Designation of files to be copied is by filename with the use of wildcards. If one or more wildcards is used for matching, then files which match but already exist on the destination disk are simply ignored and the Utility execution continues. Indication of the copied files is given on the screen as each copy is completed. This command allows duplicating a file on the same disk with a different name assigned to the new file.

COPYF 1DRIVE - This is similar to COPYF except it is set up for easy use with one drive systems.

DIR - Displays the file DIRECTORY attributes of selected files. The files to be seen are selected by filename, optionally using wildcard characters. The information displayed is: filename, creation date, size, and protection status. (CODOS GETLOC command is used to display the file load addresses and entry point).

DISKETTE - Permits direct reading and writing of physical disk sectors for debugging. Working with single or double-sided diskettes, it reads or writes specified track and sector(s) to or from a specified area in memory. A detailed error analysis is printed when a sector is unreadable.

FORMAT - Erases and re-formats a disk for CODOS use. The user can elect to copy the operating system and to have the Utility test and bypass defective disk sectors. This permits a DAMAGED DISK to be placed back into use after erasing it clean. The disk is truly unusable if an error exists in the directory or system overlay area of the disk. If this damage is found, the Utility aborts with the message "DISK UNUSABLE". Additionally, a Volume Serial Number may be assigned to uniquely identify each diskette.

KILL - Deletes file matching a given name using wildcard character matching. This allows rapid deletion of files which are no longer needed on the designated diskette. A display prompt is given for operator approval before each matched file is deleted. If a file is LOCKed, it cannot be KILLed.

UPLOAD - Transmits a text file through the serial port to an external device. The baud rate is 4800 baud (alterable by patching the program). An exact image of the file specified as the argument is transmitted. XON-XOFF protocol for handshaking is implemented with an ASCII ETX ($03) sent when the end-of-file is reached.

DOWNLOAD - Inputs a text file through the serial port from an external device to a specified disk file. The baud rate is 4800 baud with XON-XOFF protocol handshaking implemented. Receipt of an ASCII ETX ($03) or a data flow interruption of more than 3 seconds when the line is in an XON state terminates the file.

SERLDR - Loads MOS Technology standard ASCII HEX object code into memory from the serial port. An optional load address can be specified to override the load address specified on the object code module.

SERDMP - Dumps memory in MOS Technology standard ASCII HEX object code format through the serial port.

SEND - Transmits a specified ASCII message over the serial port.

RECEIVE - Waits until a specified character is received from the serial port.

WAIT - Waits for a specified number of seconds before returning to CODOS.

STRIP - Removes linefeeds and nulls from a text file to make it compatible with the MTU-EDITOR and MACASM.

SYSGENDEVICE - Changes the default system I/O device driver names, memory addresses, and characteristics. It allows addition of up to 6 custom devices such as printers besides the null device, keyboard and display.

SYSGENDISK - Permits modification of alterable disk drive attributes which are: (1) # of disks in the system, (2) # of disk buffers in the system, (3) The disk drive track-to-track step time, (4) The drive head load time.

SYSGENPRINTER - Allows creating a unique serial or parallel interface printer driver for use as the "P" device.

VMDUMP - Prints a dot-for-dot image of the MTU-130 display on the Epson (all), NEC 8023A or the IDS Prism and "Paper Tiger" 440 printers.

JOINFILES - Concatenates files. It will make a copy of a specified file at the end of another specified file. It works on any file, including digitized speech sound files.

MEMTEST - Thoroughly tests all of the MTU-130's standard memory including display and disk controller memory. Any detected errors are displayed.

CODOS 16 BIT PSEUDO PROCESSOR

CODOS contains a software simulation of a 16-bit Central Processing Unit called the Pseudo-processor (PP). The 6502 programmer can view it as an extension to the 6502 which provides 16 bit arithmetic and Utility functions. The PP uses Pseudo registers UO through U7 in page 0 as its registers, and uses the rest of memory as ordinary memory.

Executing an SVC #27 causes the PP to begin processing its instruction set beginning with the next byte. It continues executing until a PP "UEXT" instruction is encountered, at which time normal 6502 processing resumes at the next byte.

The primary value of the PP to the 6502 programmer is that it provides a very compact and easy-to-use method of performing 16-bit arithmetic, including multiplication and division, and also provides a simple way of computing 24-bit file positions for random access files. The instruction set is shown below:

UEXT	**Exit PP mode**
UADD	**16 bit add**
USUB	**16 bit subtract**
UMUL	**16 bit multiply**
UDIV	**16 bit divide**
UNUO	**16 bit move, Un to UO**
UOUN	**16 bit move, UO to Un**
USWP	**16 bit swap, UO with Un**
ULDI	**16 bit load immediate**
ULDA	**16 bit load**
UOLD	**16 bit load UO register-indirect**
USTA	**16 bit store**
UOST	**16 bit store UO register-indirect**
UNU7	**24 bit move**
UJSR	**Call subroutine at Un**
UNOP	**No operation, reserved**

APPLICATION PROGRAMS can use CODOS in two ways: the CODOS Interface Library (CIL) for interface from BASIC programs, and the SVC PROCESSOR for use from machine language programs and others. You will find an operational description of CIL under MTU-BASIC.

Machine language program interfacing to CODOS is simplified through the use of address independent SuperVisor Call (SVC) instructions. The SVC consists of a 6502 BRK instruction followed by a one byte code indicating which system function is to be performed. The SVC processor does not interfere with interrupts . Because CODOS does not use any interrupts or critically-timed loops, application programs are free to fully utilize interrupts, even during disk accesses. The following are the standard SVCs:

SVC	FUNCTION PERFORMED
0	Exit to CODOS Monitor
1	Exit to monitor with message
2	Output inline message to channel
3	Input byte from channel
4	Output byte to channel
5	Input line from channel
6	Output line to channel
7	Output string to channel
8	Convert ASCII hex to value
9	Convert ASCII decimal to value
10	Convert value to ASCII hex
11	Convert value to ASCII decimal
12	Query default I-O line buf loctn
13	Execute CODOS monitor command
14	Query channel assignment
15	Read record from channel
16	Write record to channel
17	Change file pos. to Begin-of-Data
18	Change file pos. to End-of-File
19	Specify file position
20	Query File position
21	Assign channel to file or device
22	Free channel
23	Truncate file at present position
24	Define interrupt vector
25	Define error-recovery vector
26	Restore default error recovery
27	Enter 16-bit Pseudo-processor
28	Query CODOS Version
29	Query file status
30	Query today's date

Standard CODOS I/O Drivers

These Device driver programs, written in machine language, are embedded in CODOS to provide control of the hardware devices which the user needs when using the MTU-130. The Graphic, Keyboard, and Text drivers are assumed to be in operation by CODOS. Where applicable, the drivers are table driven, allowing "jumps" to provide alternate device drivers for specialized applications.

GRAPHIC DRIVER - This driver allows the user to create graphic images on the CRT screen. The screen is described using standard rectangular coordinates, (X,Y) with positive X & Y coordinates and the (0,0) origin at the lower left corner of the screen. All arithmetic is done with 16 bit unsigned integer coordinates. Allowable ranges for X are 0 to 479 and 0 to 255 for Y. Coordinates plotted outside these ranges are forced to the appropriate legal extreme. Two forms of graphic input are available: light pen, or by positioning the GRaphic INput (GRIN) cross-hair cursor (full X and Y axis lines) with the intersection point being the pixel (X,Y) coordinate. All MTU supported high level lanaguages utilize the graphic driver.

KEYBOARD DRIVER - The keyboard is a flexible matrix encoded device. This driver encodes the standard keys into ASCII codes and the special '130 keys into additional codes. The keyboard is operated in a polled mode and all 128 ASCII codes can be generated. Full keyswitch debouncing is provided. Operator keyboard entry errors are reduced by 2-key rollover encoding which handles multiple key depressions in a predictable manner. The 4 cursor direction keys plus SPACE, BACKSPACE, RUBOUT, and DELETE character have automatic "timed out" repeat if held down for a minimum time period, with the repeat rate resettable by the user. All keys may be made to repeat using the REPEAT key. Acoustic feedback is provided for each keystroke in the form of a "click", the volume and tone of which can be adjusted or turned off if desired.

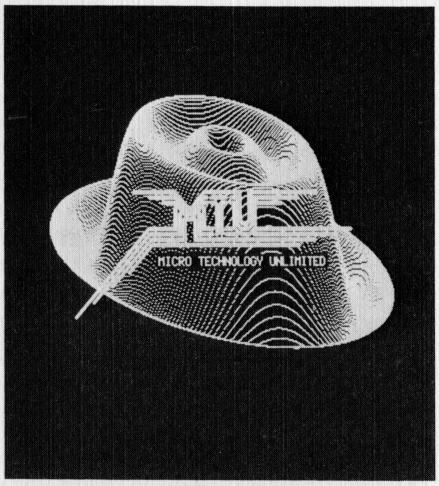
If Desired, A Custom Font Can Be Prepared With The Standard FONTEDIT Program.

TEXT DRIVER - This driver creates a standard 96 character font text display as 24 text lines by 80 characters per line. The 25th (bottom) line shows 8 rectangles which display the legends for the programmable function keys. The 96 character font is created as 5x7 dot matrix characters in a 6x10 cell. Both upper and lower case characters (with descenders and a dot over the j) are support for maximum legibility. Text can be freely interspersed with graphics. If the user desires, a custom font can be prepared with the standard FONTEDIT program and used instead of the standard font. The text cursor is located by line number and character number with home (upper left corner) being (1,1). When 80 characters are exceeded on a single line, the system performs an automatic character wrap to the display left side with the 81st character on the next line down in column 1.

PRINTER DRIVERS - Printer I/O drivers for text printing are standard with the '130. The EPSON (all), IDS (all), NEC 8023A, and the ANACOM 150 are supported. The first 3 printers are interfaced through a parallel I/O port and the ANACOM is interfaced through the RS-232 serial interface.

Graphic Printing Uses The Standard VMDUMP Utility Package

The standard SYSGENPRINTER Utility allows creating a unique serial or parallel interface printer driver. Source codes for all the standard printer drivers are provided for easy adaptation for other printer drivers.



AUTOTERM COMMUNICATIONS

This utility permits the MTU-130 to emulate a serial asynchronous terminal while performing input and output to and from files as well as the CRT monitor and/or printer. Up to three files may be in use at a time for input, output and making a record of the complete transaction. AUTOTERM uses the serial port in half-duplex with echo or a full duplex mode. The maximum baud rate is 19.2K baud for bursts of 32K bytes or less.

AUTOTERM MAY BE INSTRUCTED TO CALL A TELEPHONE NUMBER AT A SPECIFIED TIME AND TRANSMIT A FILE.

A unique feature of AUTOTERM is its ability to go into an unattended mode of operation. With suitable answers to menu questions, AUTOTERM may be instructed to call a specified telephone number at a specified time and transmit the contents of a designated file. It may also be instructed to answer incoming calls and write the received data to a designated file. These unattended features require that a D C Hayes SmartModem with matching cable be used. The interactive mode is usable with any kind of asynchronous modem.

MTU-EDITOR — AN INFINITE FILE, SCROLLING, FULL SCREEN EDITOR

For programmers, productivity is the name of the game, and the MTU EDITOR makes it happen! All you do is type. With full-screen, infinite-scroll operation, you can easily edit files much larger than memory. There is no need to memorize control codes or wait for menus, because the function key legends show the current options.

MTU-EDITOR normally accepts lines of up to 80 characters in length, but an alternate "landscape mode" can be selected which allows lines of up to 160 characters to be edited. Editing long lines is the same as editing normal length lines. The Function Key Legend Area is at the bottom of the screen and shows eight rectangles containing the legends.

TEXT	FIND	MARK	CHANGE	TABSTOP	UPDATE	QUIT	OTHER

Files may be programs, text, data, or other information stored as ASCII characters. Text files may be created and modified which are as large as the available disk space — up to one million characters on a double-sided diskette. The file portion on the screen is an exact image of the disk file, with the currently displayed portion being a "window" into the file. This window can be transparently "scrolled" through the file forward or backward or randomly positioned to any specified line. Modifications made on the window are automatically made in the file also. No requirements are placed on the user to create disk space or perform any other form of system housekeeping. Disk space is allocated or freed automatically as needed.

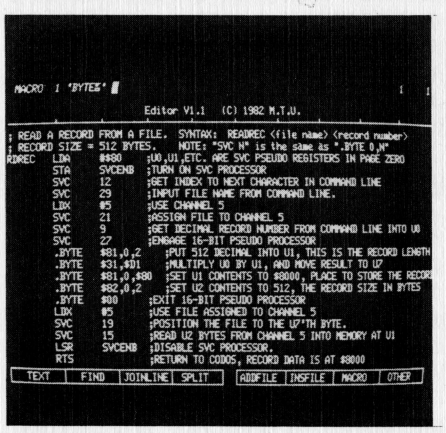
The Editor divides the console display into three areas: the Command/Status Area, the 20 line Text Window Area, and the Function Key Legend Area. The Command Area is used to display prompting messages, editing status, and commands typed in by the user. The Text Window area is set off from the Command Area by a full width horizontal line indicating tab stops. The window is 20 lines of 80 characters each.

Depression of a function key causes that associated function or "mode" to be executed immediately. Some of the command operations are described below. The descriptions are not exhaustive due to space limitations here.

Since the system always edits a file in place, it is the operator's choice to make a backup copy...

The Editor is entered from CODOS with a command such as EDIT FILENAME.T. Since the system always edits a file in place, it is the operator's choice to make a backup file copy or not, prior to making editing changes. The system prompts the user to make a backup copy of the old file, if desired, and enters the Editor. The function key line displays the legends shown above.

SCREEN EDITING begins when the TEXT key is pushed, placing the cursor in the text window. Cursor movement within the text window is controlled with the five cursor control keys. If the Cursor Down key is depressed while on the bottom line, text in the window will "scroll" up one line showing the next line in the file. If SHIFTed Cursor-Down is depressed from any position in the window, the text window is scrolled forward by 20 lines. Similarly, Cursor-Up and SHIFTed Cursor-Up can be used to scroll backwards through the file by one line or increments of 20 lines.


MACRO 1 'BYTES'
Editor V1.1 (C) 1982 M.T.U.
; READ A RECORD FROM A FILE. SYNTAX: READREC (file name) (record number)
; RECORD SIZE = 512 BYTES. NOTE: "SVC M" is the same as *.BYTE 0,M"
RDREC LDA #$80 ;U0,U1,ETC. ARE SVC PSEUDO REGISTERS IN PAGE ZERO
STA SVCENB ;TURN ON SVC PROCESSOR
SVC 12 ;GET INDEX TO NEXT CHARACTER IN COMMAND LINE
SVC 29 ;INPUT FILE NAME FROM COMMAND LINE.
LDX #5 ;USE CHANNEL 5
SVC 21 ;ASSIGN FILE TO CHANNEL 5
SVC 9 ;GET DECIMAL RECORD NUMBER FROM COMMAND LINE INTO U0
SVC 27 ;ENGAGE 16-BIT PSEUDO PROCESSOR
.BYTE $81,0,2 ;PUT 512 DECIMAL INTO U1, THIS IS THE RECORD LENGTH
.BYTE $31,$D1 ;MULTIPLY U0 BY U1, AND MOVE RESULT TO U2
.BYTE $81,0,$80 ;SET U1 CONTENTS TO $8000, PLACE TO STORE THE RECOR
.BYTE $82,0,2 ;SET U2 CONTENTS TO 512, THE RECORD SIZE IN BYTES
.BYTE $00 ;EXIT 16-BIT PSEUDO PROCESSOR
LDX #5 ;USE FILE ASSIGNED TO CHANNEL 5
SVC 19 ;POSITION THE FILE TO THE U2'TH BYTE.
SVC 15 ;READ U2 BYTES FROM CHANNEL 5 INTO MEMORY AT U1
LSR SVCENB ;DISABLE SVC PROCESSOR.
RTS ;RETURN TO CODOS, RECORD DATA IS AT $8000
TEXT FIND JOINLINE SPLIT ADDFILE INSFILE MACRO OTHER

The Editor's Eye View

The **FIND** key allows positioning the window to a specific line. Positioning is done by direct or relative (+ or –) movement by lines forward or backward from the current line, or by searching for a specific text string.

The **INSERT** key allows text to be inserted at the cursor position, pushing any remaining text on the line over to the right. SHIFTed INSERT will insert a new blank line.

The **DELETE** key deletes the character the cursor is on with all other characters to the right moving to the left. SHIFTed DELETE will delete the entire line the cursor is on.

Depressing the **UPDATE** key causes an immediate update of the disk file copy to match that portion of the file which is being edited in memory. The QUIT function key will also update the file as it terminates the edit session.

TAB STOPS can be set and cleared at any location.

The **MARK** key is used to designate a group of lines for subsequent action. The selected line is shown in reverse video. Repositioning the cursor and depressing MARK at another line will designate the second boundary. These and all intervening lines are now shown in reverse video. There is no size limit to marked blocks. The actions which can be performed on them are: MOVE, COPY, DELETE, and WRITE to a file or output device.

INSERTING AND **APPENDING** of files are provided. Text from other specified files may be inserted anywhere into the file being edited. There is no limit to insertions up to the disk limit.

The **CHANGE** key allows global or limited search and/or replace operations. The Editor will show each string that meets the search criteria in reverse video and prompts the operator for approval before the replacement is made. If disapproved, the next occurrence can be sought or the operation cancelled.

MTU-BASIC — OPENING NEW HORIZONS FOR SPEED AND FLEXIBILITY

MTU has expanded the industry standard, MICROSOFT BASIC, to include device independent I/O light pen commands, function key commands, super fast disk transfers and more. But the most important change is the addition of LIBRARIES! Each library is a set of command extensions to BASIC which can be "linked in" to customize BASIC to your needs, while using memory only for the features you need now. Since libraries are written in machine language, they are fast! Two graphics libraries and the CODOS interface library (supporting random access files, overlays, etc.) are standard.

An optional version, MTU-BASIC 1.5, is compatible with MTU-BASIC 1.0 but runs programs up to 34K bytes in size with up to 64K bytes for data space. Additionally, it taps the power of the 68000 microprocessor on the DATAMOVER board, or just the data and array expansion with the PROGRAMMOVER board.

The following describes the commands and characteristics that are available with standard MTU-BASIC 1.0.

* All arithmetic is performed using floating point with a 9 decimal digit precision, and a range of ±10**38.

* Variables may consist of two characters the first of which must be alphabetic.

* Arrays may have any number of dimensions. Variable length string variables and arrays of string variables are provided. Individual strings may be up to 255 characters long.

String Functions	Arithmetic	Relational Operators	Boolean Operators	String Operators	Reserved Variables
ASC	+	=	AND	+	ST
CHR$	-		OR		KE(Y)
LEFT$	*	>=	NOT		
LEN	/	<>			
MID$	^	<=			
RIGHT$		=>			
STR$					
VAL					

Program Statements		Commands	Arithmetic Functions	I/O Statements And Functions
DEF	PEEK	BYE	ABS	DATA
DIM	POKE	CLEAR	ATN	GET
END	REM	CONT	COS	INPUT
FOR..NEXT	RESTORE	EDIT	EXP	PRINT
GOSUB	RETURN	ENTER	FN	READ
GOTO	STOP	FRELIB	FRE	SPC
IF/THEN (GOTO)	TONE	LIB	INT	TAB
LEGEND	WAIT	LIST	LOG	POS
LET		LOAD	POS	OUTCHAN
MCALL		NEW	RND	
ON/GOTO (GOSUB)		RUN	SGN	
		SAVE	SIN	
			SQR	
			TAN	
			USR	

LEGEND allows legending of all the programmable function keys with a single command.

KEY is a reserved variable. Its operation is ideally suited for use in ON..GOTO or ON..GOSUB statements. This makes function key driven application programs simple to implement.

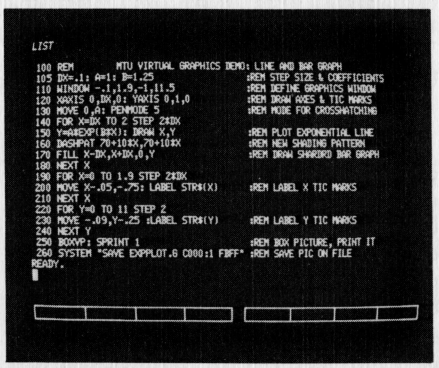
LOAD and **SAVE** — The LOAD command recalls the specified file from disk and loads it into the bottom of BASIC memory. The SAVE command stores the program currently in BASIC memory to the disk. The lines are recalled or stored in tokenized memory image format.

LIST and **ENTER** commands permit ASCII data to be written or read instead of the tokenized memory image format. When using the LIST command, if no device or file name is given, the listing will be shown on the display. The ENTER command reads the specified ASCII file from disk and adds the lines into the program currently in memory.

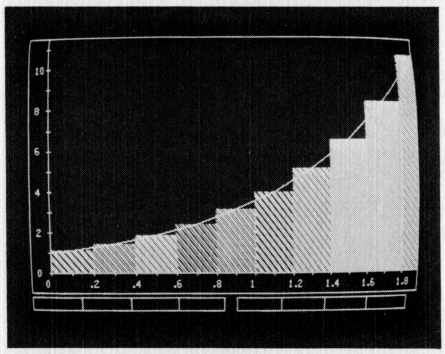
INPUT and **GET** commands normally receive data from the keyboard but the input channel may be assigned to any input device or file. In addition, the INPUT command has been upgraded so that if a flag is set, a null response (CR only) will return a null string or a zero value instead of halting the program.

LIB and **FRELIB** commands are used to add (LIB) Command Libraries and delete them (FRELIB) from the operating MTU-BASIC command set.

BYE returns control to CODOS from BASIC.


LIST
100 REM MTU VIRTUAL GRAPHICS DEMO: LINE AND BAR GRAPH
105 DX=.1: A=1: B=1.25 :REM STEP SIZE & COEFFICIENTS
110 WINDOW -.1,1.9,-1,11.5 :REM DEFINE GRAPHICS WINDOW
120 XAXIS 0,DX,0: YAXIS 0,1,0 :REM DRAW AXES & TIC MARKS
130 MOVE 0,A: PENMODE 5 :REM MODE FOR CROSSHATCHING
140 FOR X=DX TO 2 STEP 2*DX
150 Y=A*EXP(B*X): DRAW X,Y :REM PLOT EXPONENTIAL LINE
160 DASHPAT 70+10*X,70+10*X :REM NEW SHADING PATTERN
170 FILL X-DX,X+DX,0,Y :REM DRAW SHADED BAR GRAPH
180 NEXT X
190 FOR X=0 TO 1.9 STEP 2*DX
200 MOVE X-.05,-.75: LABEL STR$(X) :REM LABEL X TIC MARKS
210 NEXT X
220 FOR Y=0 TO 11 STEP 2
230 MOVE -.09,Y-.25 :LABEL STR$(Y) :REM LABEL Y TIC MARKS
240 NEXT Y
250 BOXVP: SPRINT 1 :REM BOX PICTURE, PRINT IT
260 SYSTEM "SAVE EXPPLOT.6 C000:1 FFFF" :REM SAVE PIC ON FILE
READY.

THAT IMAGE ⟶



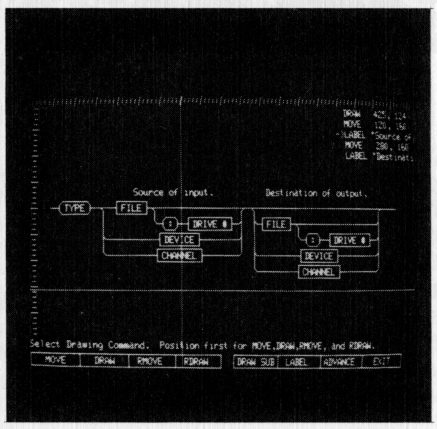
WAS CREATED BY ⟵ THAT PROGRAM

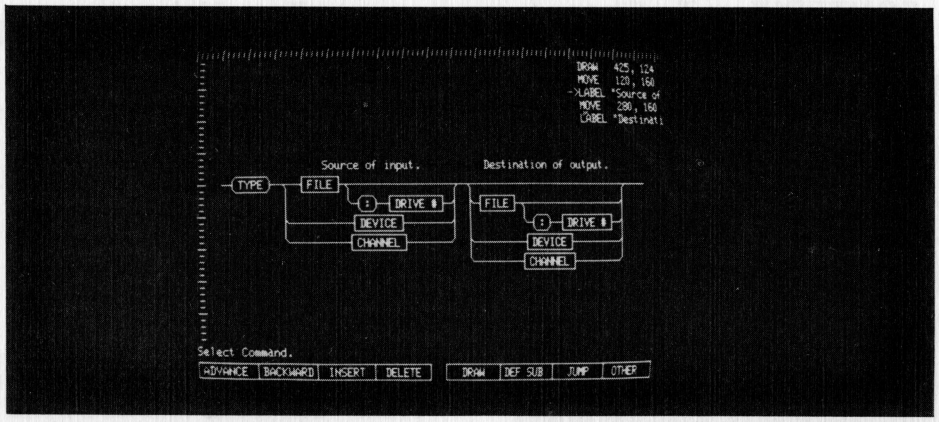
MTU-BASIC has the expanded ability to link in external machine language Command Libraries. Up to 8 Libraries may be simultaneously linked, with commands of one Library superceding those of another. The added commands may be executed from the console in immediate mode or from a running program. They may use expressions, variables and strings as arguments as well as constants and literals. This system provides a flexible way of making MTU-BASIC extensible and upward compatible. Anticipation of special commands for future applications is no longer necessary since special cases can be handled when the need arises. Three Libraries come standard with MTU-BASIC.

Virtual Graphics Library

VGL provides a powerful 2-dimensional graphics capability using floating point values to specify points in terms of "user world" coordinates with automatic display scaling and windowing functions. All lines or points which fall outside the presently displayed window are automatically clipped at the window boundary. This allows a program to expand the detail in a small portion of a plot to the full screen size by redefining the window before plotting the data. In addition a viewport can be called, defining the physical screen portion to be occupied by the window.

Another major feature of VGL is the "GRaphic INput" command. When this command is executed, a graphic crosshair fullscreen horizontal and vertical line cursor appears on the screen. The current intersection of these two lines can be "steered" to any point on the screen with the four cursor controls. The coordinates read back are given in terms of the user's data coordinate system.





VGL also allows relative coordinates which are especially useful when a shape element is to be repeated several times. Additionally, VGL has been designed to work in conjunction with the IGL Library. This allows free mixing of both text and graphics anywhere on the screen. Thus, charts and graphs may be titled for better understanding.

Some VGL example commands are below:

VIEWPORT: defines area of display screen to use as a viewport.
WINDOW: defines virtual coordinate space the viewport displays.
GRIN: allows coordinate input with the GRIN cursor. Returns virtual X,Y coordinates.
XAXIS, YAXIS: draw axes of specified length, tic mark spacing and size.
DASH X,Y: draw dashed line from the current cursor position to X,Y.
ERASE X,Y: Erase line from the current cursor position to X,Y.

Integer Graphics Library

IGL works with integer arithmetic for simple graphic plotting. Coordinates may be 0-479 for X and 0-255 for Y with no scaling. Provision is made for drawing lines, moving without drawing, drawing dashed lines, input from the light pen and plotting text at any x,y position. Some of the commands are shown below:

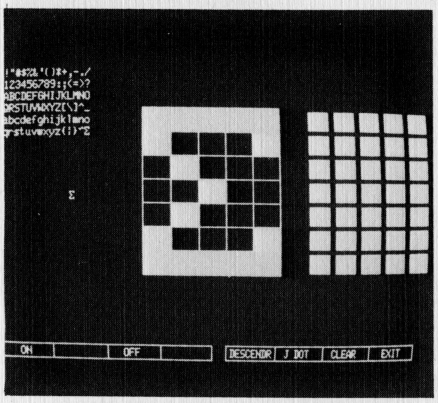
SMOVE X,Y: moves the graphics cursor
SDRAW X,Y: draws a line from the cursor to x,y
TCURSOR R,C: moves the text cursor to row R and column C
TWINDOW T,N: sets scrolling text window top=T and max text lines=N
LABEL B$: prints the string B at the graphics cursor location
SPRINT: prints a dot for dot image of the MTU-130 display. The same printers are supported as for the VMDUMP utility described previously.

CODOS Interface Library

CIL provides a convenient and flexible method for BASIC programs to read and write CODOS data files either randomly or sequentially. Using the BLKWRT and BLKRD commands, numerical data can be transferred between disk and data arrays read from a channel at speeds of 32K bytes in 2.6 seconds. Consistent with MTU's commitment to flexibility, the INPUT@ command has a settable flag which indicates whether a comma should be interpreted as a separator of string data, or read as part of the string. Additionally, using the SYSTEM command, all CODOS commands may be accessed. Some of the commands are shown below:

BLKRD@: Reads data from a channel into variables or arrays
BLKWRT@: Writes variables or arrays in memory image to a channel
GET@: Reads one byte from a channel
INPUT@: Reads ASCII text from a channel
ONERR: Establishes execution point in program for handling CODOS errors.
POSITION@: Sets the file assigned to the channel to a specified point
POSN (N): Returns the current position of the file assigned to channel N.
PRINT@: Writes ASCII data to a channel.
PUT@: Writes one byte to a channel.
SYSTEM: Permits the running program to execute any CODOS command

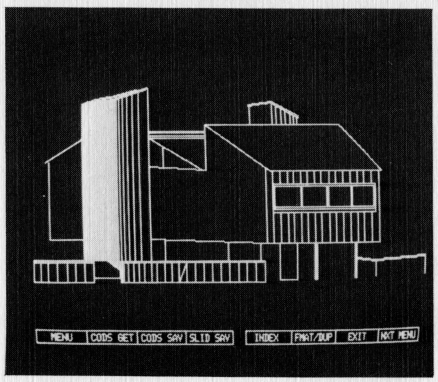
FONTEDIT — To Change The Character Set



With this BASIC program you may change the standard character font used for the display. Changes can be made since the font table is stored in read/write memory, and may be replaced by simply loading in another one. For example, revised font tables containing Greek, Math Symbols, or other language characters could be placed in use simply by programming the function keys to load the appropriate font when that key is pressed. Once a character is drawn on the display, its definition is no longer needed in the font table. Changing the font is done by use of the light pen to select the appropriate dots in a 5 x 7 matrix including provisions for descenders for p, y, etc. in a 5 x 9 area. This program also allows saving of the newly constructed font using the function keys.

GREDIT — For Creating Graphic Images

This is a simple graphics drawing package using the GRIN cursor steered by the cursor control keys. Points may be located, lines drawn, labels entered, and each step of the process saved for later use. Subshape capabilities allow easy repetitive drawing of the same shape.

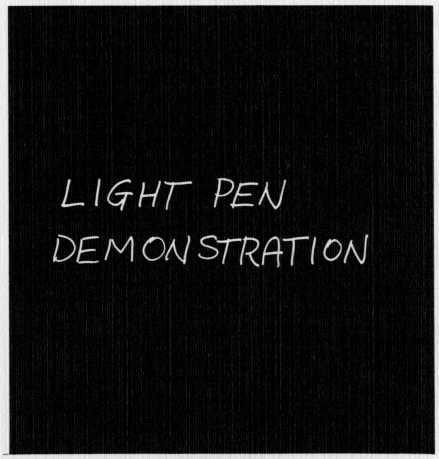


Four-Voice Music Software

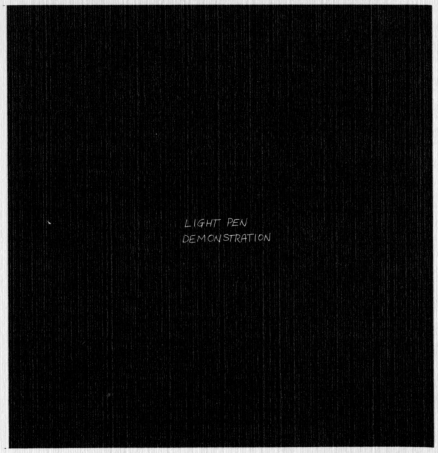
This software package allows the creation and playing of multi-part music as described in an article by Hal Chamberlin in the September 1977 issue of Byte. The musical tones produced have a limitless variety of different waveforms with the rectangular envelope giving an organ-like timbre.

Using SPLAY, the Simplified Music Interpreter, each musical "event" requires as little as 2 bytes of storage. Provisions for separate waveforms for each voice, variations in tempo, changes in timbre, and "musical subroutines" are available. It accepts song table code generated by the standard SNOTRAN Compiler or by hand.

The MTU-EDITOR may be used to create a song table in ASCII character format and store it as a CODOS file. Using the SNOTRAN Compiler, the file can then be compiled into interpretive code for SPLAY and output as a file to disk. The file can then be "played" by SPLAY.



THIS SHOWS THE LIGHT PEN CAPABILITY



THAT CAN BE SCALED DOWN TO THIS

Demonstration Programs

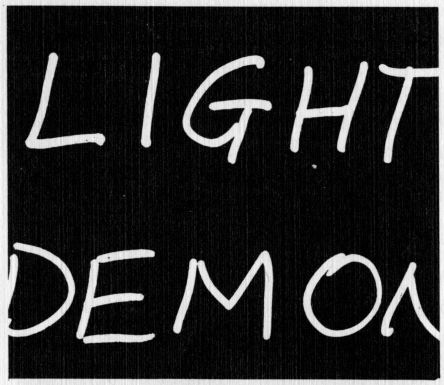
The MTU-130 system includes a demonstration diskette containing a large number of programs designed to demonstrate the capabilities of this powerful system. All programs are initiated by the user pushing the appropriate function key — thus no complex interaction with the computer is necessary for an initial use of the system. One program, AUTODEMO, will automatically step through most of the programs without further user action. Just under 500 KBytes of demonstration images and programs are provided.

A number of predigitized speech files allow the computer to address the user in natural sounding words — not a strange sounding computer dialect.

Seven musical scores are provided to play with the four-voice music software SPLAY routine.

Graphics speed and variety on the '130 are shown by programs which plot random figures, and random size checkers filled by both black and white and gray scale areas.

The light pen capabilities are shown by a program which allows the user to write or draw directly on the CRT monitor screen followed by a capability to redisplay in various sizes that which was drawn.



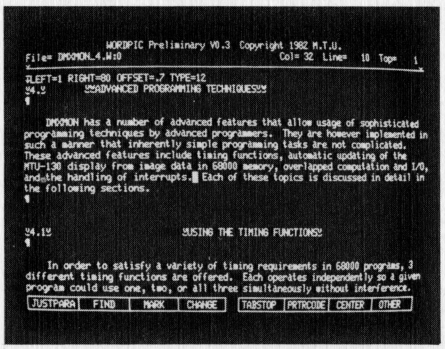
THAT CAN BE BLOWN UP TO THIS

Two game programs are also included. POOL is an animated graphics simulation of a pocket billiards game. The user inputs the desired aiming point using the GRIN cursor. The balls move in approximately real time on the screen. In SHOOT, two opponents try to blow up each other's cannon, while shooting over a mountain with variable winds.

MTU-130 OPTIONAL SOFTWARE DESCRIPTIONS

WORDPIC — Equation, Picture and Word Processor

The MTU-130 takes Word Processing another step into the information age with the optional WORDPIC program. Like the MTU-EDITOR, WORDPIC can easily handle documents up to the size of a full double-sided diskette! In addition to the standard word processing features you would expect, with WORDPIC you can create text reports which include graphic image "figures". These figures can be up to 1,280 dots wide by 2,047 dots high and can be printed between paragraphs OR beside text columns. Figures may include any type of graphic image such as tables, graphs, digitized photographs, or MTU-130 screen images. They may be generated using MTU-BASIC, MTU-C, GREDIT, etc. or any other method which creates a dot matrix image and stores it in a disk file. Figures may be inserted, moved, and deleted during the edit session and appear in their graphic form at print time. In addition, full scientific or mathematical equations can be embedded anywhere as shown below. Imagine the impact of including graphical data in reports generated on your personal system at home or at work.


WORDPIC Preliminary V0.3 Copyright 1982 M.T.U.
File= DMEMON.4.W10 Col= 32 Line= 10 Top= 1
.LEFT=1 RIGHT=80 OFFSET=.7 TYPE=12
.H.U "ADVANCED PROGRAMMING TECHNIQUES"
DMEMON has a number of advanced features that allow usage of sophisticated programming techniques by advanced programmers. They are however implemented in such a manner that inherently simple programming tasks are not complicated. These advanced features include timing functions, automatic updating of the MTU-130 display from image data in 68000 memory, overlapped computation and I/O, and the handling of interrupts. Each of these topics is discussed in detail in the following sections.
.H.U "USING THE TIMING FUNCTIONS"
In order to satisfy a variety of timing requirements in 68000 programs, 3 different timing functions are offered. Each operates independently so a given program could use one, two, or all three simultaneously without interference.
JUSTPARA FIND MARK CHANGE TABSTOP PATRCODE CENTER OTHER

Even with all its sophistication, WORDPIC is one of the easiest word processors to use. Unlike other systems, no memorization of "control keys" or complex key sequences is necessary. Instead, WORDPIC is controlled by simply pressing the function keys whose legends are displayed on the CRT. As you make function key selections, the legends change instantly to reflect the new functions now possible. A full screen editing technique is used to display text on the CRT virtually the same as it will appear on the printed document.

Unlike many word processors which limit document size to a few hundred lines or less, WORDPIC can edit documents of up to the maximum size available on disk, normally 1,000,000 characters on a double sided disk. Any portion of the document can be rapidly selected for display using automatic, bi-directional scrolling. The '130 displays full 80 character lines, with the ability to edit lines of up to 160 characters. The full ASCII character set is displayable, including lower case letters with descenders.

The standard CODOS keyboard driver is replaced by one which is interrupt driven with N-key rollover and type-ahead buffering which insures no keystrokes are lost and no keyswitch bounce occurs, no matter how fast you type. Using the five separate cursor keys, you can move the cursor rapidly and accurately to any position on the screen. When held down, these keys repeat automatically after a brief delay, and multiple cursor keys can be held down for diagonal movements. The standard INSERT and DELETE keys on the main keyboard allow rapid editing for beginner and expert typists alike.

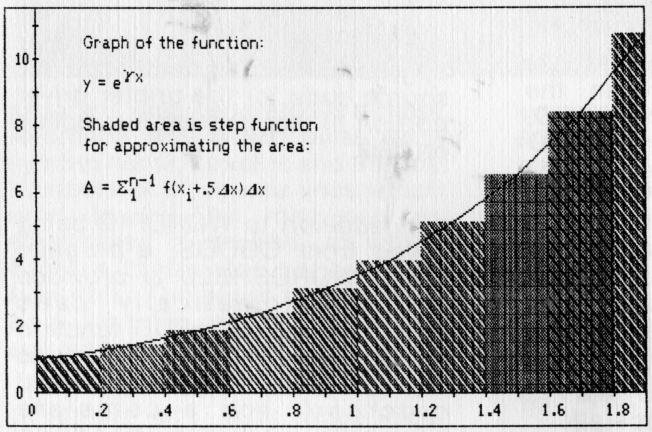
Text entry can be accomplished in either insert or overstrike mode. In insert mode, entered text pushes existing text on the line to the right as it is entered. Overstrike mode is used to type-over existing text. In either mode, as text entry on a line overflows the right margin, "word-wrap" operation automatically brings words down to the next line without any words being broken.

Both left and right margins can be varied as often as desired within the document. When pushed, the JUSTPARA function key immediately justifies text between the margins on the screen and in the file. If margins are reduced or expanded, pushing the JUSTPARA key will automatically "funnel" or "expand" the text as needed to fit between the new margins. You can even create a "reverse indented" paragraph with the top line full to the left margin and subsequent lines inset from the margin a specified amount. Subsequent editing and JUSTPARA operations will not remove or destroy this reverse indentation.

WORDPIC™

WORD/PICTURE PROCESSOR FOR MTU-130 COMPUTERS

Micro Technology Unlimited brings a whole new dimension to Word Processing with the introduction of WORDPIC for the MTU-130 computer. For the first time, you can print high-resolution graphics information mixed with your text! What other word processor can do this:



Using WORDPIC you can print high-resolution graphics images of up to 1280 x 2048 pixels, intermixed with text. You can print text beside graphics, text over graphics, multiple pictures side by side or superimposed, etc. Graphics images created by BASIC programs, MTU's Graphic Editor, or other programs can be directly merged with the text. CRT screen images and even digitized photographs can be used. Graphic images can be inserted, deleted, and moved by WORDPIC just as easily as ordinary text. The graph at the left was created by an 18 line BASIC program.

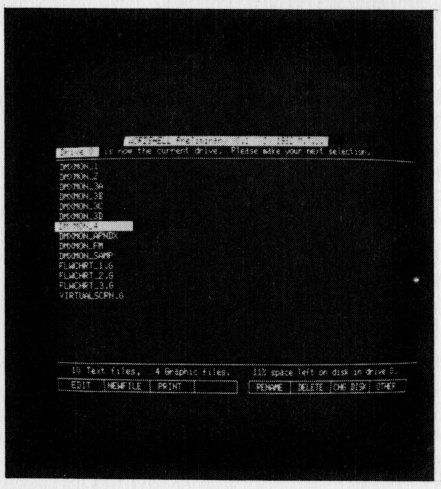
Both tabstops and margins are easily set or changed and may be altered literally any number of times within the document. Both types of positions are stored with the document and are recalled automatically when the document is edited. The current tabstop and margin settings are shown graphically at all times.

WORDPIC can perform full search and replace operations which may be limited to specified columns or line ranges. Operator "veto" may be selected to allow approval of each occurrence of a string match prior to replacement.

Designated multiple line blocks of any size, anywhere in the document can be DELETED, COPIED, MOVED, SAVED AND RECALLED. Blocks of text can be written to other files, and other files can be inserted anywhere. The last deletion up to 3,000 characters can be recalled with two keystrokes. This applies to both line deletion and designated block deletions.

A special feature allows you to "teach" WORDPIC new editing operations with up to 9 operations being defined and operational at any given time. Thus, you can customize WORDPIC to your own needs.

You can specify underline, subscript, superscript, bold and wide character operations, alone or in any mix. You can mix pica, elite, condensed, and proportional printing within the same document. You can call for "ragged", "flush right", or "proportional" justification, and alter line spacing too. WORDPIC displays indications of all these special modes on the screen while you are editing. You don't have to print out the document to find out where printing modes change. You may take full advantage of printers with extended character sets (such as Greek or math symbols) with WORDPIC, as it supports displaying and alternate font in addition to the standard font.

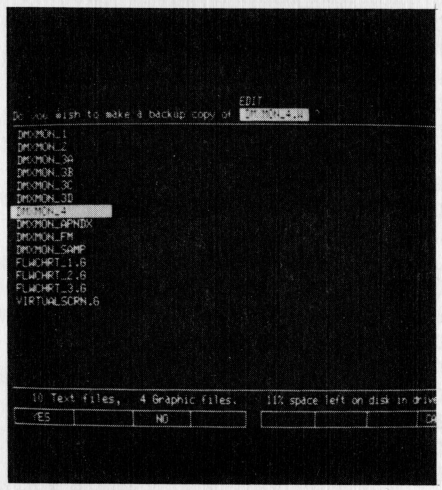


Combining the graphics and equation capability with WORDPIC's proportional printing and proportional spacing gives documents a typeset appearance. WORDPIC presently supports the NEC 8023A dot matrix printer which gives correspondence quality printing in a 2-strike operation. Additional printer support can be added by MTU upgrades, or by others since the source code for the printer driver portion of the program is supplied on disk.

In addition to WORDPIC being called from CODOS, a program called WORDSHELL is provided which automatically calls WORDPIC when the EDIT function key is pushed. WORDSHELL turns the '130 into a dedicated word processor for a complete neophyte. All file handling functions can be executed from WORDSHELL by selecting the appropriate function to be performed. These are: **EDIT, DELETE, RENAME, COPY ON THE SAME DISK, COPY TO A DIFFERENT DISK, CREATE A NEW FILE, PRINT A FILE, CHANGE A DISK, and DISPLAY THE NEXT INDEX PAGE.**

WORDSHELL shows the disk contents on an index page. A status/command area is at the display top and the function key legends at the bottom. Just above the legends is shown the number of text files on this disk, the number of graphic image files (.G), the % of disk space left, and which disk is being edited. The selected filenames displayed may be used or edited by WORDPIC. These files are shown in 5 columns with 20 rows of filenames per column sorted alphabetically top to bottom, left to right, to make locating the desired file easy.

The user selects the desired file by positioning the cursor to that filename. Depressing the cursor left or right arrows moves the cursor to the next column, one column per keystroke or repeat movement. The cursor wraps around at the margins to the opposite margin. Depressing the cursor up or down arrows moves the cursor to the next row. The cursor wraps around at the top/bottom edges to the opposite edge. That filename containing the cursor is shown in reverse video to indicate that it is selected.



For example, the image above shows the screen after the operator has pushed the EDIT function key with a filename selected. Note the message "Do you wish to make a backup copy?" on the command/status line and the function key legends which have changed to YES, NO and CANCEL. Only these choices are permitted. If YES is selected, you must enter the filename for the backup copy, then WORDPIC is invoked and the designated file is opened for editing.

With these two programs you are armed with word processing power that matches the power of the MTU-130. As many of you know, our history is steeped in designing word processing equipment for the "office industry". We now are bringing this experience onto the MTU-130.

MACASM — 6502
Macro Assembler

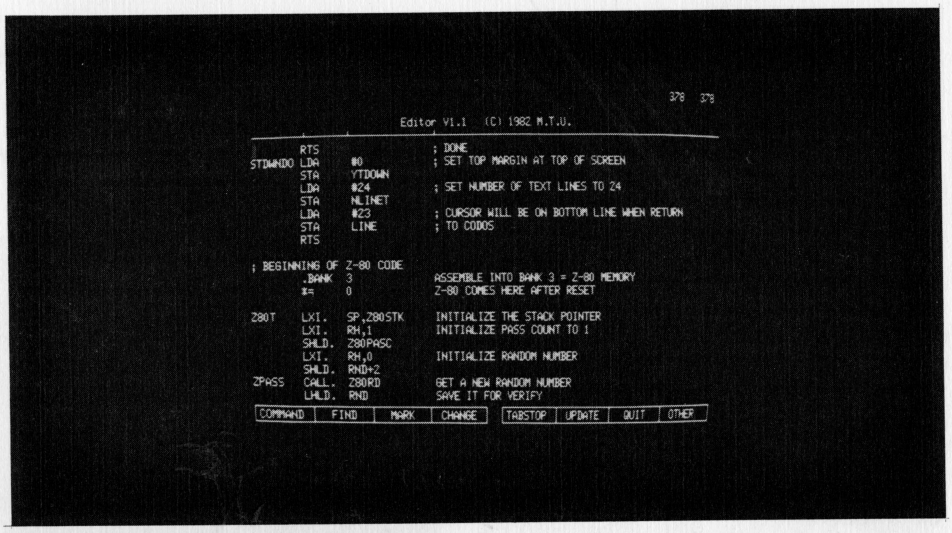
For machine language programmers, the optional MACASM can handle anything you and the MTU-EDITOR can throw at it. MACASM is a disk based, two-pass resident assembler using standard assembly language syntax and mnemonics. Macros, "include" files, and conditional assembly are supported, plus a unique DEFINITIONS directive for linking separately assembled modules.

MACASM accepts standard MOS Technology format source code from an ASCII file on disk. Source files may be as large as necessary, up to the full 1 MByte capacity of a disk. The generated object code, symbol table, cross-reference map, and program listing may be on a disk other than the one containing the source code file. Because MACASM outputs the object code to a disk file, there are no "reserved" areas of memory where programs cannot be assembled. Multiple non-contiguous blocks of object code or data can be produced, and saved in a single disk file. This file can be loaded from disk and executed with a single CODOS GET command.

Source program identifiers may contain up to 31 characters, all of which are significant. The only reserved symbol is the character "A", which denotes the accumulator addressing mode. Numeric operands may be specified in binary, octal, decimal, or hexadecimal. All expressions are evaluated using triple precision arithmetic, allowing values in the range of -8,388,608 to +8,388,607 decimal. Eleven operators including multiplicaton and division are permitted.

The listing file may be suppressed or redirected to a printer or other device during assembly. It shows each source statement, a line number, and the object code generated. Erroneous source lines encountered are entered into the listing and are displayed on the CRT with an error message. Each erroneous line is flagged immediately underneath with a pointer to the offending portion of the line and a short English error message shown below that. An error count is displayed at the end of the assembly.

The symbol table is alphabetically sorted and consists of a list of all symbol names used in the program. Also generated is a cross reference map which gives each symbol name, its value and the line numbers of all source lines which refer to it. This map can be suppressed if desired, in which case an abbreviated symbol table is printed. The entire symbol table and listing output can be suppressed, if desired.


378 378
Editor V1.1 (C) 1982 M.T.U.
RTS ; DONE
STDWNDO LDA #0 ; SET TOP MARGIN AT TOP OF SCREEN
STA YTDOWN
LDA #24 ; SET NUMBER OF TEXT LINES TO 24
STA NLINET
LDA #23 ; CURSOR WILL BE ON BOTTOM LINE WHEN RETURN
STA LINE ; TO CODOS
RTS
; BEGINNING OF Z-80 CODE
.BANK 3 ASSEMBLE INTO BANK 3 = Z-80 MEMORY
*= 0 Z-80 COMES HERE AFTER RESET
Z80T LXI. SP,Z80STK INITIALIZE THE STACK POINTER
LXI. RH,1 INITIALIZE PASS COUNT TO 1
SHLD. Z80PASC
LXI. RH,0 INITIALIZE RANDOM NUMBER
SHLD. RND+2
ZPASS CALL. Z80RD GET A NEW RANDOM NUMBER
LHLD. RND SAVE IT FOR VERIFY
COMMAND FIND MARK CHANGE TABSTOP UPDATE QUIT OTHER

Macros and conditional assembly are both supported. Macros may be invoked with up to 36 arguments of any length, and may be nested up to 8 levels and invoked recursively. Local labels are supported. Eight conditional assembly tests are provided, including tests for the absence of arguments and total number of arguments specified in a macro. As a demonstration of the power of MACASM, a set of macros is provided which permits MACASM to assemble 8080 code for downloading to another microprocessor or the PROGRAM-MOVER board. This effectively provides an 8080 cross-assembler.

Special files called the "Definitions" file and the "Externals" file can be used to link to separately-assembled programs or data areas. A unique capability called "Direct definitions" is supported which permits temporary parameter redefinition without modifying the source code file.

A .READ pseudo can be used to read alternate source files during assembly. This feature allows standard libraries of macros or routines to be used conveniently. Nesting of .READS can be done up to three files deep.

MACASM is written entirely in machine language, optimized for speed of assembly. For example, a 5000 line source program with 800 symbols assembles in under four minutes, including generation of object code, listing, symbol table and cross-reference map all stored on disk. Assembly typically progresses at about 2500 lines per minute with the listing suppressed and about 1500 lines per minute with the listing assigned to a disk file. The symbol table is large enough to handle about 1800 identifiers with cross-references.

A disassembler is also provided to display standard 6502 mnemonics of a designated number of lines of output or a designated section of memory.

DMXASM — 68000
Macro Cross Assembler

DMXASM is a macro cross assembler running on the 6502 which assembles 68000 code using Motorola mnemonics. It has features similar to MACASM, but assembles 68000 source files. DMXASM runs on standard MTU-130 systems and does not require the 68000 based DATAMOVER board to perform assemblies. If the DATAMOVER or other expansion memory is present, DMXASM "sniffs" for the additional RAM in Bank 3 and uses this memory for the symbol table, allowing larger quantities of symbols to be used. The object code output is stored on disk in DMXMON loadable form (see DATAMOVER page for a description of DMXMON). This allows creations of a 68000 based program which can be loaded and run simply by typing its name while in DMXMON or from a STARTUP file.

MTU-BASIC 1.5
The Faster Version

MTU-BASIC 1.5 is an upgraded version of the standard MTU-BASIC 1.0 which offers two major advantages. First, it allows use of the bank switching ability of the '130 and second, if available, the 68000 is used for speed acceleration. BASIC 1.5 expects the '130 to contain a memory expansion board to allow its expanded storage capabilities. This memory expansion may be either a PROGRAMMOVER or a DATAMOVER board. If both are present, the more powerful DATAMOVER will automatically be chosen.

When large arrays are required, the available memory for program and data can be used up rather quickly. BASIC 1.5 helps eliminate this problem taking advantage of the bank switching capability of the '130 to separate program space from data space. BASIC 1.5 gives you over 34,000 bytes of memory for program space, and over 64,000 bytes for data space. That means you can dimension a **60,000+ byte 100 by 120 floating point array** and still have over 34,000 bytes available for your program. The bank switch handling of the separation of program space from data space is done entirely by the interpreter and is totally transparent to the BASIC programmer.

"... with speed improvement up to 600% possible ..."

When present, the 68000 processor is used to perform various operations which improve the execution speed of BASIC programs. These operations include transcendental functions, floating point arithmetic, assisting with the string garbage collection and assisting with the accessing of variables and arrays. Also, the 68000 processor keeps the location of the starting point of each line of the current BASIC program in a table. This table allows GOTO and GOSUB statements to find their destination much faster. Even with these changes, MTU-BASIC 1.5 is 100% compatible with MTU-BASIC 1.0.

Programs using functions such as SIN, COS, ATN, SQR, EXP, and LOG are helped the most with speed improvement up to 600% possible when these functions dominate. Programs doing time consuming calculations on multi-dimensioned numeric arrays run up to 300% faster. Very large programs with hundreds of lines and individual variables are also substantially sped up, but very small programs or those dominated by string manipulation may show no speed improvement.

Included with BASIC 1.5 is a new version of the standard CIL Library, upgraded to transparently handle the bank switching operation. For your database and scientific work, this package should raise some eyebrows!

KGL — Keyword Graphics Library

The Keyword Graphic Library is an optional general purpose graphics Command Library which can be linked into MTU-BASIC 1.0 or 1.5. There are several features of KGL not available in the IGL and VGL graphic Libraries. First, KGL supports the definition of 4 separate "window" areas which may be any portion of the display. Drawing and printing is restricted to the current window. Second, KGL contains a powerful block move capability which allows flexible repositioning of graphic areas or scrolling of text areas. Third, KGL has its own internal character drawing capability. This subroutine interprets special drawing codes for shape definition. A set of such definitions, included with KGL provides the complete ASCII character set. The user is given instructions for creating custom shape definitions using strings of VECTORBYTES, single bytes defining; a move or draw, which of eight 45 degree directions and from 1 to 14 dots in length. These VECTORBYTES can be chained together to create custom shapes which can be scaled and rotated in 90 degree increments.

MTU-C — The Language of the 1980's

This is virtually the full C language, as described in Kernighan and Ritchie's manual. The C programming language is considered by many to be the finest programming language available today. This modern language combines high-level structured programming principles with highly efficient code generation. It allows the programmer to operate in the high level language and when necessary go to machine language levels with the same ease.

This high performance compiler version produces a compact P-code which is executed by a P-code interpreter running on the 6502. A full interface to CODOS has been built into the compiler and the runtime interpreter permitting the full power and flexibility of CODOS. MTU-C is a full implementation of the language, including floating point operation. Except for bit fields, all features defined in Kernighan and Ritchie's manual are fully implemented, including:

(1) Char, int, short, long, float, and double data types
(2) #define and #include
(3) Multi-dimensional arrays, pointers, and structures
(4) Library functions

In addition to the C compiler, a linker-loader is included which allows separately compiled modules to be combined into an executable program. It will automatically load only those pre-compiled C or assembly language modules needed from a library. C programs are compiled to a compact intermediate P-code which is executed by a small run-time package. Execution speed is many times faster than BASIC. The more complex the program, the greater the speed increase. MTU-C is eminently suited for development of serious application programs. System houses will be especially pleased to know that there is no derivative license fee for software developed using C to be run on MTU-130 computers.

More Optional Languages, Diskette Read/Write Facility And CP/M Operating System

P-SYSTEM — From SOFTECH Microsystems

This package includes all software necessary to make the SOFTECH MICROSYSTEMS' UCSD P-SYSTEM operational on the '130. It allows the P-SYSTEM to use double density disk operation, and automatic handling of double and single sided disks. The standard UCSD disk operating system is retained and runs independently of CODOS, permitting use of the full range of available software for this system.

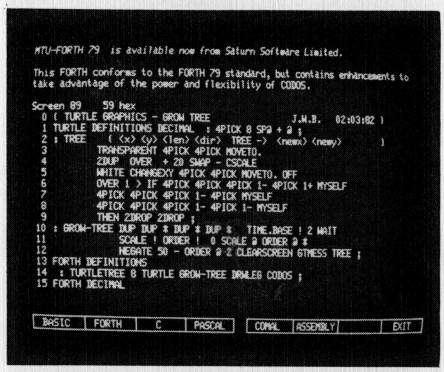
The package supports a PRINT device interfaced through a parallel port, and a REMOTE device interfaced through the serial port. Source code is provided for these interfaces to allow additions or changes which may be desired (requires MACASM for reassembly).

P-PASCAL — With MTU Graphics

The SOFTECH version IV of the UCSD PASCAL language is available running under the P-SYSTEM. MTU supplies an extension Library of graphic functions available for use by PASCAL application programs. This library implements most of the functions available in the MTU-BASIC IGL library, including a procedure for accessing the light pen. A simple demo program is provided to illustrate how to use these graphics routines.

P-FORTRAN — UCSD SOFTECH Version

The SOFTECH version of the UCSD FORTRAN language is also available running under the P-SYSTEM.


MTU-FORTH 79 is available now from Saturn Software Limited.
This FORTH conforms to the FORTH 79 standard, but contains enhancements to take advantage of the power and flexibility of CODOS.
Screen 89 59 hex
0 (TURTLE GRAPHICS - GROW TREE J.W.B. 02:03:82)
1 TURTLE DEFINITIONS DECIMAL : 4PICK 8 SPa + @ ;
2 : TREE (<x> <y> <len> <dir> TREE -) <newx> <newy>)
3 TRANSPARENT 4PICK 4PICK MOVETO.
4 ZOUP OVER + 20 SWAP - SCALE
5 WHITE CHANGEXY 4PICK 4PICK MOVETO. OFF
6 OVER 1 > IF 4PICK 4PICK 4PICK 1- 4PICK 1+ MYSELF
7 4PICK 4PICK 4PICK 1- 4PICK MYSELF
8 4PICK 4PICK 4PICK 1- 4PICK 1- MYSELF
9 THEN ZDROP ZDROP ;
10 : GROW-TREE DUP DUP 2 DUP 3 DUP 4 TIME.BASE ! 2 WAIT
11 SCALE ! ORDER ! 0 SCALE @ ORDER @ 2
12 MEBATE 50 - ORDER @ 2 CLEARSCREEN GTMESS TREE ;
13 FORTH DEFINITIONS
14 : TURTLETREE 8 TURTLE GROW-TREE DRAWLEG CODOS ;
15 FORTH DECIMAL
BASIC FORTH C PASCAL COMAL ASSEMBLY EXIT

MTU-FORTH — An Extensible Compiler

MTU-FORTH, developed by Jack Brown, is a compiler compatible with the FORTH 79 implementation of the FORTH language. It is a complete programming system, offering an interactive language which is user extensible as well as the ability to easily incorporate 6502 assembly langauge code.

In addition to the standard FORTH, there are built in, ready to load extensions including a standard FORTH style editor, a screen editor, a set of graphics definitions, and an implementation of a software real time clock. There is also a FORTH compatible 6502 assembler, which accepts both CODOS SVC opcodes and double length (4 byte) numbers. As a final built in extension, there is a set of CODOS related definitions which allow MTU-FORTH to run in conjunction with CODOS. This differs from some implementations of FORTH which contain their own simplified operating systems which use FORTH disks written in a special format. Because of the extra capabilities of CODOS, a "FORTH disk" is implemented as a CODOS text file of sufficient length to hold the desired number of FORTH screens. This difference is transparent to FORTH programs and allows FORTH programs to write CODOS compatible files with no extra effort. There are numerous other examples and demos provided on disk along with the thorough 140 page reference manual.

CP/M — Z-80 Operating System

The CP/M 2.2 operating system from Digital Research Corporation is supplied on an 8" floppy diskette with operating manuals. All necessary modifications to the BIOS have been made to allow CP/M to run on the MTU-130, controlling the standard floppy disk drives.

Use of CP/M on the '130 requires the PROGRAMMOVER board. More memory is available than on most standard CP/M systems because the disk operations are aided by the 6502 processor and its associated memory. The 6502 processor, running concurrently, serves as a peripheral processor to relieve the Z-80 of time-consuming I-O tasks.

DISKEX — Foreign Disk Format Utility

This disk exchange Utility allows ASCII text or data files to be exchanged between CODOS and other floppy disk systems. Both read and write operations are permitted. To write a file in a supported format, the disk being written to must contain a named file large enough to accept the data or text being transferred. The systems supported include:

1. **CP/M**
2. **IBM 3270**
3. **FLEX**

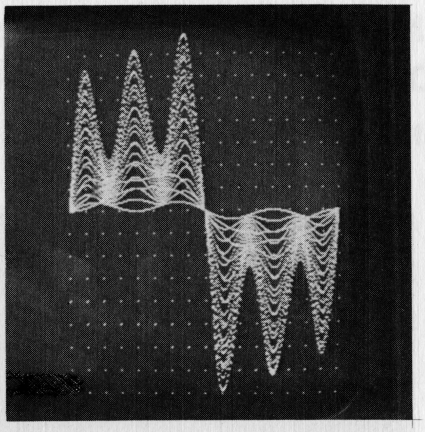
NOTE: DISKEX alone does not allow the user to RUN CP/M or the other operating systems, only transfer files on 8" diskette. Additionally, not all IBM systems using 8" floppy diskettes have the same file format.

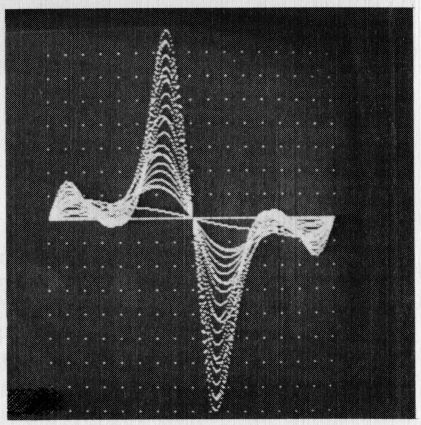
INSMUS-8 — Instrument Synthesis Music

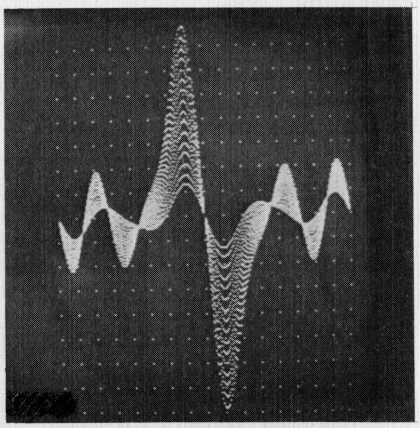
This software package allows the creation and playing of 4-part music with generalized envelope control as described in an article by Hal Chamberlin in the April 1980 issue of BYTE. This package was developed with the help of Dr. Frank Covitz specifically for the MTU-130. The sounds generated by this package and its included demonstration scores will amaze all listeners, whether they have an ear for music or not. This is truly a remarkable piece of work which is highly recommended for everyone.

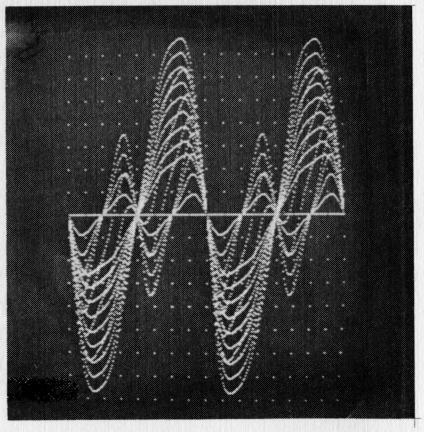
The user can specify an amplitude envelope for EACH harmonic in the tones used. Thus the overall amplitude and harmonic structure of the tone may vary during the duration of individual notes. When coded instrument specifications are based on published analyses of common musical instruments, the resulting sounds from this system closely resemble the analyzed instrument. The greatest power, however, comes from the ability to define original instrument sounds.

All of the routines needed to compute waveform tables from instrument data are part of the music playing program. Once the tables are computed, an overlay plot of the waveshapes may be made on the '130 display.









INSNOTRAN — Instrument Music Compiler

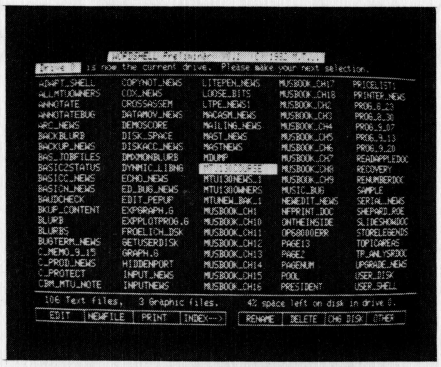
Coding of song scores can be done in the native INSMUS code similar to hexadecimal coding or it can be generated using the optional INSNOTRAN compiler. The music language for INSNOTRAN is an alpha-numeric technique much easier to learn and use than INSMUS native code, and is upward compatible with the Simplified 4-part NOTRAN compiler that comes standard with every MTU-130. INSNOTRAN is designed to run on the MTU-130 system and can compile the ASCII file directly from disk, reference instruments in a library on disk by name, perform automatic instrument selection based on pitch, and has rhythmic micro-adjustment capability for more "human" sounding music.

An additional MTU development underway will produce a graphic score entry and editing system using the light pen and function keys which will output the song code to control INSMUS.

USERSHELL — Create Your Own Interface Environment

Because of the power and flexibility of the MTU-130, we have written this general purpose program which creates an interface environment for the casual walk-up or untrained user. Such a program is often called a "shell" program since it isolates the user from much of the detail involved with using a system. With USERSHELL, a simple set of file handling functions can be executed by selecting and depressing the appropriate legended function key.

Supplied along with USERSHELL runtime code is a file containing the assembly language source code. Thus, for those who can program in assembly language, USERSHELL can serve as the starting point for implementing a SHELL program which is customized for your specific application. Such a SHELL program can allow neophyte users



to begin using the application software without knowing any details about how to use the MTU-130 or the CODOS operating system.

USERSHELL shows the selected disk contents in a display window on the CRT. The filenames are displayed 5 columns by 20 rows. A command area is at the display top and a status line at the bottom, just above the function key legends. The command area is used to display various messages and requests for input. The status line shows the number of files on the disk, the % of disk space left, and which disk drive is being accessed. The files are shown in the columns sorted alphabetically by file extension first, then by file name. This sorted list is displayed top to bottom, left to right, to make locating the desired file easy.

The user selects the desired file by positioning the cursor to that filename. Depressing the cursor left or right arrows moves the cursor to the next column, one column per keystroke or repeat movement. The cursor "wraps around" at the margins to the opposite margin. Depressing the cursor up or down arrows moves the cursor to the next row. The cursor "wraps around" at the top/bottom edges to the opposite edge. The filename containing the cursor is shown in reverse video to indicate it is selected. Various functions will use this selected filename as the file on which to perform their operation.

The various functions are initiated by pressing the appropriate function key. For those customizing their own SHELL program, any of the standard functions may be retained, and any new ones needed may be added.

USERSHELL is configured to display all the files contained on a disk. However, it may be easily reconfigured to display only a subset of these files based on selection of the single character file extension. This allows you to keep files from displaying when they are not relevant to the specific application.

SLIDESHOW — High Speed Graphic Image Presentation And Creation Program

The MTU-130 has several programs for creating graphic screen images. SLIDESHOW incorporates many of these methods into a concise operating program designed for efficiency of creating graphic image "slides" stored on disk. The second function of this program allows high speed selection and presentation of slides on the CRT display and/or external CRT monitors for classroom or presentation viewing.

SLIDESHOW is useful for drawing and preparing graphic images from scratch, manually annotating images produced by other programs. Complete facilities for preparing images either by freehand use of the light pen or manipulation of the graphic crosshair cursor are available. Annotation may use characters of selectable sizes, stroke thicknesses, and fonts. Additionally, slides may be created by overlaying new or existing slides onto other existing slides.

When used to display slides in a live presentation, SLIDESHOW gives you all of the capabilities of an overhead projector. Slides may be selected at random for display and two or more slides my be overlayed on the display without affecting the individual stored images. If the user's monitor is adjusted for a bright background, the light pen may be used as a "pointer" that will be visible on the "house" monitors which are adjusted for normal display. A "chalk" mode for the light pen allows the speaker to draw right on top of a displayed slide at will.

Slides are kept on diskettes recorded with a special format which holds either 40 slides (single sided) or **80 slides** (double sided). All slides are full 480 wide by 256 high pixel images. Any slide may be selected at random and fully displayed in less than 1 second. Sequential slides (slide # increasing) may be displayed at the rate of **2.5 slides per second**! Functions are provided for transfer of slides to and from standard CODOS format files as well as copying slide disks. Operation of SLIDESHOW is accomplished through the use of the function keys.

MTU-130 Optional Software

This section has described the optional software programs available. The list is growing with the addition of new software monthly by MTU and external software houses. MTU works very closely with individuals and companies to create new software features for the '130 system. If you are interested in writing new or converting existing software to run on the '130, please call MTU in Raleigh, North Carolina (919) 833-1458 and let us know. We are willing to help you in any way we can.

MTU-130 USER GROUP AND MTU UPDATE NEWSLETTER

MTU UPDATE is the current vehicle for disseminating information to the MTU-130 USER GROUP. UPDATE is published quarterly and mailed out to owners of MTU-130 systems and other selected persons. Programs submitted by users are collected during the period between MTU UPDATE issues. These are compiled to form the next volume of the MTU-130 USER GROUP DISKETTE. Those who make submissions on diskette receive a copy of the new USER DISK back on the disk they sent in. It should be noted that these programs are currently submitted only for use on the MTU-130 system.

MTU-130 User Group Diskette #1

ANNOTATE — Allows adding text headlines to graphic images in variable size and shapes with variable densities.

VBFONTENTER — Allows creation of custom character shapes for ANNOTATE.

APPLEREAD — Allows reading APPLE tapes on the '130 and store to disk.

APPLEWRITE — Allows writing APPLE tapes on the '130 from disk.

ARCH — Plots Archimedes spiral using user defined parameters.

BIRDSHOT — This is a flying bird game where the user fires a directable gun at a flying bird.

BREAKER — A rewritten version of breakforth from BYTE August, 1980.

CBMMTUMOD — Converts tokenized form of PET BASIC programs to MTU BASIC.

CONVERT — Converts decimal to hex, octal, or binary and vice-versa

DISKSPACE — Subroutine to determine free disk space from a running program.

FLIST — Prints ASCII files from disk to an output device adding attributes.

MDUMP — Specialized screen editor which allows direct manipulation of the DATAMOVER RAM.

POOL — An animated pocket billiards game with all 16 balls moving simultaneously. Now standard on all '130 demo disks.

PIRATE — A pirate adventure game.

RANDOM — Demonstrates graphics drawing speed under BASIC.

RENUMBER — A BASIC program to renumber a BASIC program.

SLIDESHOW — A program to read hi-res images from APPLE cassette tape and store them to disk. (Not the MTU slideshow.)

SORTSTRING — A BASIC quick-sort program using CIL.

STARTREK — The Startrek game.

SURVIVAL — An adventure game requiring the player to use his wits to escape the moon.

TAPEANLYSR — Uses a graphic screen to help analyse input from '130 cassette tape input port.

User Group Diskette #2

AN1 — These are all of the common programs from the book "SOME COMMON BASIC PROGRAMS 3rd EDITION", plus a few extras. There are over 90 programs provided.

MENU1 — A menu program to help select and run AN1 programs.

CONVERT — Converts decimal to hex, octal or binary. Also hex and octal to decimal.

TREK — TREK program modified to run with IGL and VGL for speed. Well commented for user modification.

RENUMBER — Machine language Utility which renumbers the BASIC program in memory. Accepts starting line number and increment. Corrects all line number references in GOTO's and GOSUB's, etc.

DIRLINKTAB — Utility which prints memory dump showing a disk Block Allocation Table and Directory.

MAZEMAKER — Generates mazes on display using a weighted and slightly modified version of a spanning tree algorithm from BYTE 1981.

PASSWORD — Program which when inserted in the STARTUP file, prevents a person from gaining access to CODOS during a BOOT operation unless he enters a user-definable password from the console.

PCM8023 — Machine language program which allows rapid setting of the NEC 8023A printer's various printing modes and formats.

UNLIST — Utility program which converts an assembly listing file into source file that may be reassembled.

SHEPARD — This is an infinite series of tones in which each successive note seems to be higher in pitch than its predecessor.

AIMTP — Reads AIM-65 format cassette tapes through the '130 port and stores the information on disk.

SKIPOVER — Sets the VFU vertical forms control in the NEC 8023A printer to automatically skip over the perforations in fanfold paper.

MTU-130 OPTIONAL HARDWARE DESCRIPTIONS

MULTI-O BOARD

This multi-function board is designed to add additional Input and Output device ports to the MTU-130. It plugs into the CPU module, deriving all necessary power from the backplane connector. All additional I/O ports are made available at connectors mounted in a small chassis which easily mounts to the back side of the MTU-130 case, behind the backplane. All cables between the board and these connectors are hidden, entering the MTU-130 case through one of the 1x3.5" cutout holes provided. Included on this board are the following functions:

12 Bit Analog to Digital Converter

* 8 single-ended or 4 differential channels
* Inputs protected up to ±200V.
* Random software channel selection.
* Sample and hold for accurate reading of changing signals.
* Separate analog ground minimizes ground noise in the single-ended mode.
* Type 6522 interface IC has 2 timers for autosampling at programmable intervals.
* Total per-channel conversion time of 70uS (max) including channel selection, sampling, A/D conversion and reading.
* Ultra-high impedance FET inputs eliminate errors due to lead resistance, allow simple external R-C noise filters.
* 2 interrupt inputs and 2 control outputs available at the analog connector, independent of other parallel I/O ports.

12 Bit Digital to Analog Converter

* Settling time is 25uS to .01% for a full scale step.
* Output ranges 0 to +10V, ±5V, ±10V.
* Near zero output impedance, maximum load current is 10mA.
* Output is short circuit protected.

Perpetual Clock/Calendar Chip

* A hold function allows unambiguous reading of the time.
* Timing accuracy within 30 seconds per month (max), 10 seconds typical.
* Software selectable interrupts every second or every hour.
* User supplied standard battery for backup.
* Time in HH:MM:SS WW DD:MM:YY format including full 2 digit years counter and leap year logic.

IEEE-488 BUS Interface

* Full IEEE-488 standard implementation.
* Talker, listener, and controller.
* Programmed I/O data transfers.
* Hardware requires minimal software intervention.
* Up to 20K bytes/sec continuous to disk transfers standard with CODOS.
* Up to 80K bytes/sec burst rate.

8 Bit Parallel I/O Ports

* Two full ports provided with 4 handshaking lines (full 6522).
* +5V, and ±12V DC are supplied in the connector.
* On-chip timer clock frequency is 1.0 MHz ±.02% accuracy.
* All signal lines provided on one single connector identical to the standard parallel I/O connector.

Serial Ports

* Two ports provided with independent baud rates from 50 to 19,200 baud, capable of both synchronous and asynchronous operation.
* Modem control signals are provided on one port (CTS, DSR, DCD, DTR, RTS).
* Standard EIA ±12V levels used on all interface signals.
* External baud rate provisions on one port as required for synchronous operation.
* Each port has a separate connector identical to the standard MTU-130 serial I/O connector.

Standard MULTI-O software consists of the following and includes source codes for all the programs.

Demonstrations And Utilities

AUTODATE: when this utility is inserted in the STARTUP file, it eliminates the need to enter the date when the system is turned on.
TIMESET: for resetting the time/date.
WAITUNTIL: waits until a designated clock time occurs and returns.
AUTOTERM: This upgraded version of the standard program additionally allows using the MULTI-O serial ports (in asynchronous mode) as well as the standard '130 port.

* A version of SYSGENPRINTER that creates a printer driver using the MULTI-O serial and/or parallel ports.
* A digital voltmeter and storage oscilloscope demonstration for the analog inputs.
* A programmable voltage source demonstration for the analog outputs.

Interface Subroutines

* An I/O driver for one IEEE-488 device for assignment to a CODOS channel.
* A BASIC library for general IEEE-488 bus operations.
* A machine language subroutine package callable by assembly, C, Pascal, etc. for general IEEE-488 bus operations.
* A BASIC library for handling analog and parallel I/O, and the clock or calendar.
* A machine language subroutine package callable by assembly, C, Pascal, etc. for handling analog and parallel I/O, and the clock or calendar.

Diagnostic Programs

* Loop-around tests for the serial and parallel ports.
* Loop-around tests for the analog output and inputs.
* Clock/calendar functional test including a timing accuracy check.
* IEEE-488 interface test.

DATAMOVER BOARD — 68000 MICROPROCESSOR AND 256K OF RAM

When you plug this board into your MTU-130, you enter an expanded realm of '130 high-technology power. The DATAMOVER adds a 16/32-bit 8MHZ 68000 microprocessor and 256K bytes of RAM, but retains total compatibility with the standard '130. This means that your comfortable and familiar system still acts and feels the same. CODOS, the graphics display, light pen, keyboard, etc., all behave as they did before, but now you have increased speed and compute power. This is what should be expected from a fully utilized 8-bit system. Adding 16-bit power simply makes more things happen faster, both for the programmer and the user.

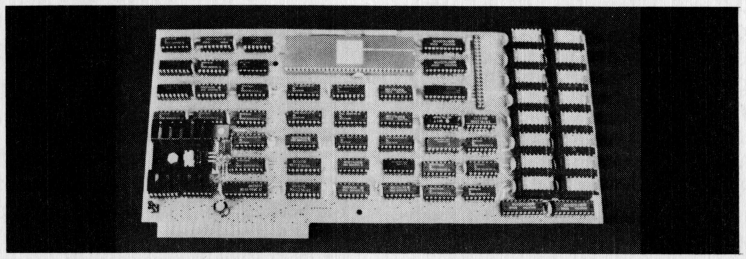
The DATAMOVER is useful for memory intensive applications, as a floating point math accelerator, as a larger graphics display area processor, and as a vehicle for running the many powerful structured languages being introduced for the 68000. Two DATAMOVER boards may be installed in a single '130 with both operating independently at full speed, simultaneously with the 6502 processing. In addition, they may be operated with PROGRAM-MOVER Z-80 boards installed and running.

The 256K bytes of memory on-board the DATAMOVER may be accessed by the 6502, 128K bytes at a time. All of the DATAMOVER memory is directly accessible by the 68000 for both program and data storage. In addition to interprocessor communication via shared memory, bidirectional interrupts provide efficient closed-loop control of simultaneous tasks. A memory expansion plug is included on the DATAMOVER for installation of up to 768K of optional memory on a piggyback board. This additional memory may also be directly mapped into the 6502 to manipulate up to 1 Megabyte of memory, 128K bytes at a time. The time to load 256K bytes of storage from floppy disk is 15 seconds including directory search and file opening time!

The 68000 processor has sixteen 32-bit registers, 14 addressing modes, and 56 instructions including hardware multiply and divide. A full 16 bit multiply with 32 bit product is completed in 9 microseconds. It can directly manipulate bits, BCD digits, bytes, words and 32-bit long words. The 68000 is acknowledged by most experts as the state of the art in microprocessors, surpassing other available 16 bit microprocessors in performance.

DMXMON Operating System

The DATAMOVER board comes supplied standard with DMXMON, a cross monitor program that makes the '130 appear to the user and programmer as if it were in fact a 68000 based system. DMXMON is designed to make all of the '130 facilities that are normally available to the 6502 programmer also available to the 68000 programmer. DMXMON is a CODOS work-alike with all of its power and convenience so there is no need to learn a new operating system.



DMXMON uses the 6502 as a peripheral processor to relieve the 68000 of routine I/O chores for maximum performance. It performs in both a CONSOLE mode operated from the Keyboard and CRT and an EXECUTION mode which slaves the 6502 to the 68000 and its programs. When DMXMON is entered, the system is in the Console mode where you are directly accessing the 68000, its registers and the memory it uses, just as in CODOS with the 6502. In the Execution mode, a standard interface is created, allowing 68000 programs to access all the '130 built-in features, using the 6502 as a slave Input-Output processor. Both processors can run simultaneously and can share DATAMOVER memory.

For the user, DMXMON offers the complete array of CODOS file maintenance commands such as FILES, RENAME, DISK, KILL, TYPE, and others. These operate exactly like their CODOS counterparts. The 68000 programs and/or Job files are executed simply by typing their name along with any required arguments.

For the 68000 programmer, DMXMON offers an extensive array of over 90 SVCs (supervisor calls) that allow access to all CODOS and '130 I/O functions. All of the applicable CODOS SVCs are provided as well as SVCs for every major entry point into the standard text and graphics routines available on the '130. Additional SVCs allow a 68000 program to read/write any 6502 memory location, call 6502 subroutines, and control multiple timers.

One series of SVCs permits any portion of the 68000's memory to be displayed as graphics on the '130 screen. A typical graphic array of 1536X1024 dots may be easily manipulated by the 68000 and displayed through a 480X256 movable "window" on the '130 screen. You can select whether to perform a "window" move to a new location on demand, or to move and/or continuously copy at 5 frames per second!

For debugging, DMXMON offers an extensive array of memory manipulation commands, execution error messages, and 68000 program breakpoints. All of the standard CODOS memory manipulation commands such as SET, FILL, HUNT, DUMP, COMPARE, etc., are provided and now operate on the DATAMOVER memory. Full 24 bit addresses are recognized and 32 bit arithmetic is used in expressions. When the 68000 recognizes an error condition such as an illegal instruction, DMXMON will report it with an English error message showing the problem location and full register contents. Up to 4 breakpoints may be set simultaneously to facilitate debugging.

The '130 is truly a system that can grow with you. In this time of rapid technology advances, can you really afford to be saddled with a computer that is anything less?

PROGRAMMOVER
Z-80A Processor Board With 64K RAM

This is a processor and memory board which expands the MTU-130 with a 4 MHz Z-80A processor and 64K bytes of additional 2-port memory. This board has three functions: (1) It allows the MTU-130 to run CP/M, (2) It is a 64K RAM expansion board for the 6502, and (3) It is a hardware printer spooler board.

The board contains 64K bytes of 2-port RAM, a 4 MHz Z-80A processor, a serial port and a Centronics parallel port. One memory port is connected to the Z-80 and the other to the 6502 bus. Access to the memory is controlled by on-board logic to prevent any interference between the two processors. A board enable register is provided with control by the 6502 through address $BFB6 or $BFB7 in Bank 0, allowing the board to be disabled from the bus under software control. The two processors can communicate through the shared memory and can interrupt each other.

When the 6502 bus port is enabled, the board can be operated as a slave Z-80A processor executing any Z-80 or 8080 machine language program. The board is supplied with memory test software. The CP/M 2.2 operating system is optional (See CP/M Section).

The 64K of RAM can be used alone for 6502 memory expansion, being addressed in either bank 2 or 3. Two PROGRAMMOVER boards may be used together in the system, or simultaneously with DATAMOVER boards.

The board can function as a spooler buffer with a dedicated program loaded for the Z-80 to run either a serial or parallel device. The user supplied Z-80 program is downloaded and can be changed under application software control. In excess of 60K bytes are available for output buffering. For example, if a printer driver Z-80 program is loaded into the memory and then a file to be printed is loaded and the Z-80 instructed to run the program, the file will print while the 6502 is doing something entirely unrelated. This same function can be performed with interrupt operation in the main program, but MTU offers you an alternate mode of operating when interrupts are undesirable.

MULTIDISK
Rigid And Floppy Disk Board

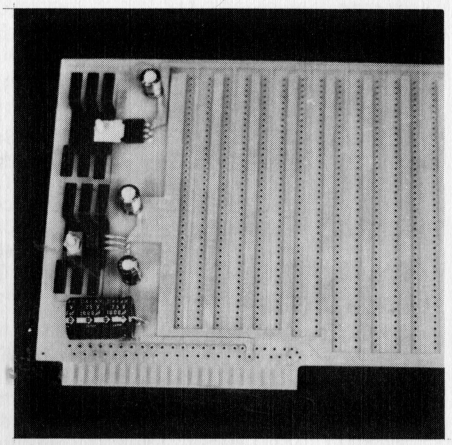
MTU plans to release a rigid disk system in the 1st quarter of 1983. This mass storage system will use a 100 mm (3.8") removable media Winchester drive. Startup time from disk insertion is 15 seconds and the system is controlled by the standard CODOS operating system, making all existing CODOS software compatible. The formatted capacity of the drive is 5 Megabytes. Backup may be performed through the use of a second rigid drive with removable cartridge or at 2M bytes per minute to MTU 8" floppy disk drives (including disk change time).

Systems with the rigid disk feature will use a different disk controller board which is capable of controlling both floppy and rigid disks. The floppy portion of the controller will be functionally identical to the controller used in the standard MTU-130 now. The rigid disk portion of the controller will use a rigid disk controller chip which allows control of up to 4 rigid disk drives. On-board memory consists of 32K bytes; 16K at the top of bank 0, and 16K just below the display memory in bank 1.

Data transfers to and from both controller chips is done via direct memory access to the on-board RAM. Additionally, an independent 6502 microprocessor is available to provide intelligent disk data buffering and look-ahead for higher performance operations. This processor uses a portion of the on-board RAM (rather than ROM) for its program storage for maximum flexibility. The on-board resources may be accessed by the local processor or over the bus from the MTU-130's main 6502 processor.

EPROM Programmer

MTU offers an EPROM programmer for 2716, 2732 EPROMS. If you need one call MTU for a quote.



PROTOTYPING Board

This board is designed for construction of custom electronic circuits using either wire-wrap or hand wiring techniques. The board contains a universal hole pattern allowing mounting of integrated circuit components on spacing centers from 0.1" to 0.9". The board is covered with voltage and ground planes on opposite sides. Voltage regulators and bypass capacitors are provided on-board for +5 and +12 volts. A manual is provided to allow the user to document the circuit built on this board.

GENERAL PRICE LIST

(Valid through March 1, 1983)

FULL SYSTEMS

200010	MTU-130-1D	Full 1 Drive System Less Manual #270000	$4400
200020	MTU-130-2D	Full 2 Drive System Less Manual #270000	$4945
200040	MTU-130-4D	Full 4 Drive System Less Manual #270000	$7245

For Applications Requiring Separate Boards, Or Custom Systems, Please Call MTU.

APPLICATIONS

210000	WORDPIC	Word Processor Less Manual #280010	$385
214001	SIMPLEMUS	6502 4 Voice Simple Waveform Music	STD
214002	INSMUS-8	6502 Instrument Synthesis Music	$80
214003	INSNOTRAN	6502 Compiler For INSMUS-8	$50
214100	SLIDESHOW	6502 Based Slide Creation/Presentation	Call
216001	POOL	Machine Language Pool Game	Std

OPERATING SYSTEMS AND UTILITIES

220000	CODOS 2.0	6502 Channel-Oriented Operating System	Std
220001	MTU-EDITOR	Full Screen, Infinite Scroll Editor	Std
220002	AUTOTERM	Interactive & Unattended Communications	Std
220003	DISKEX	Disk Exchange Utility Less Manual #280020	$140
220004	USERSHELL	Source Code	$25
221000	DMXMON	68000 Channel-Oriented Operating System	Std W/DM
222000	CP/M 2.2	Z-80 Operating System	$150

LANGUAGES

230001	MACASM	6502 Macro Assembler Less Manual #280030	$80
230002	DMXASM	68000 Macro Cross Assembler Less Manual #280031	$190
230101	MTU-BASIC	Includes VGL, IGL, CIL Libraries	Std
230102	MTU-BASIC 1.5	Revision 1.5 Upgrade	$50
230103	KGL	Additional Graphic Library	$50
230201	P-SYSTEM	SOFTECH P-SYSTEM	$475
230301	P-PASCAL	SOFTECH P-SYSTEM PASCAL (Requires #230201)	$375
230401	P-FORTRAN	SOFTECH P-SYSTEM FORTRAN (Requires #230201)	$375
230501	MTU-C	6502 Full C Language Less Manual #280100	$190
230601	MTU-FORTH	6502 Full FORTH Language	$150

DISTRIBUTION AND USER DISK SOFTWARE

240001	USER DISK 1		$15
240002	USER DISK		$15
240100	DIST 1.4	CODOS Distributed Diskette 1.4 Upgrade	$15
240200	10 DISKETTES	Blank Dysan 2 Sided, Double Density	$75

MTU DESIGNED HARDWARE PRODUCTS

250000	DATAMOVER	68000 Board Less Manual #270010	$1465
250005	PROGRAMMOVER	4MHz Z-80A Board Less Manual #270012	$440
250100	MULTI-O	Expanded LAB I/O Less Manual #270011	Call
250110	PROTOTYPE	Wire Wrap Prototype Board	$50
250200	MULTIDISK	Floppy And Rigid Disk Board Less Manual	Call
250300	DIGISOUND-8	Audio Sound System	Call
250401	FDISK MODULE	Dual 8" Floppy Expansion Module	$2300
250500	PARACABLE2	Parallel Device Cable With 2 Connectors	$65
250501	PARACABLE3	Parallel Device Cable With 3 Connectors	$85
250502	SERIAL CABLE2	Serial Device Cable With 2 Connectors	$40
250600	GROUP NUMBER	Custom Requested Group Number In ROM	$50

HARDWARE MANUALS

270000	MTU-130 M	MTU-130 User/Service Manual	$50
270010	DATAMOVER M	DATAMOVER Hardware/Software Manual	$35
270011	MULTI-O M	MULTI-O Manual	Call
270012	PROGRAMMOVER M	PROGRAMMOVER Hardware Manual	$10

SOFTWARE MANUALS AND BOOKS

280010	WORDPIC M	WORDPIC Word Processor Manual	$10
280020	DISKEX M	DISKEX Manual	$10
280030	MACASM M	6502 Macro Assembler Manual	$10
280031	DMXASM M	68000 Macro Cross Assembler Manual	$10
280200	MTU-C M	MTU-C User Manual	$10
280201	C-BOOK	The C Programming Language: Kernighan & Ritchie	$18

EXPANSION PERIPHERALS FROM OTHER MANUFACTURERS

300001	SMARTMODEM	DC Hayes With SERIALCABLE2 (250502)	$345
300002	SMRTMODEM 1200	DC Hayes With SERIALCABLE2 (250502)	Call
300100	NEC 8023A	Printer With PARACABLE2 (250502)	$650
300200	QUME DT8	QUME DATATRACK 8 Floppy Drive	$895

30 Day Return Warranty (Valid Through March 1, 1983)

MTU warrants all shipped MTU-130-XD systems to meet the published specifications in this catalog or purchased units can be returned within 30 days of purchase for full refund (less shipping charges).

Repair Plan

Units under warranty requiring repairs are to be returned to the factory postpaid. These will be returned postpaid within 2 weeks from the date of receipt. For special repair requirements, contact your dealer or MTU directly. Out of warranty repairs are available on the same schedule as listed above. Minimum charge for factory repairs is $30.00 plus parts.

Delivery

All MTU-130-XD complete systems are normally 30-60 days delivery from receipt of order. Other products are normally available off-the-shelf for one week delivery.

Trademarks

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Micro Technology Unlimited
Order Form

Micro Technology Unlimited
2806 Hillsborough Street
P.O. Box 12106
Raleigh, N.C. 27605 U.S.A.
(919) 833-1458

Name _____ Day Phone (_____) _____-_____

Ship To Address _____

_____

City _____ State _____ Zip Code _____

Ship By: _____ (UPS standard)

Quantity	MTU Number	Description Of Each Item	Cost Each	Total

NORTH CAROLINA residents add 4% Sales Tax

SHIPPING and **INTERNATIONAL CHARGES** are found on the reverse side of this form.

PAYMENT METHOD for individuals is prepay or COD, terms for qualified institutions who apply.

MINIMUM ORDER is: $20 for prepay, $30 for COD or Bank Card ($500 maximum with Bank Card) $50 for terms. COD orders over $1000 must be paid by cashier's check or cash.

SUBTOTAL	
N. C. SALES TAX	
SHIPPING CHARGES	
INTERNATIONAL HANDLING	
ORDER TOTAL	

VISA®

master charge
THE INTERBANK CARD

Shipping Charges Computation

All shipping of MTU-130 systems is done by UPS in the United States. To use the charts below, use the first 3 digits of your postal zip code (123XX) to determine your UPS ZONE. Then determine the cost to ship the desired system or peripheral to your zone. Use this cost on the order form on the reverse side of this page. If the product you are ordering is not listed on this page, MTU pays the freight (in the United States).

UPS ZONE	FIND THE FIRST THREE DIGITS OF YOUR POSTAL ZIP CODE
2	230-241, 243, 245, 249, 270-286, 295, 297
3	150-156, 159, 172-174, 197-229, 242, 244, 246-248, 250-259, 261, 268, 287-294, 296, 298-299, 304-306, 308-309, 313-314, 376-379, 407-409, 411-418, 457
4	010-029, 034, 036, 051-053, 060-089, 100-128, 130-149, 157-158, 160-171, 175-196, 260, 300-303, 307, 310-312, 315-319, 335-338, 350-364, 367-374, 382-385, 388, 393, 397, 400-406, 410, 420-456, 458-495, 609, 618-619, 624, 628-629, 637-638
5	030-033, 035, 037-050, 054-059, 129, 330-334, 339, 365-366, 380-381, 386-387, 389-392, 394-396, 496-508, 513-554, 559-560, 600-606, 610-617, 620-623, 625-627, 630-636, 639-668, 673, 680-681, 700-729, 740-745, 747-749, 754-759, 776-777
6	510-512, 556-558, 561-585, 669-672, 674-679, 683-693, 730-739, 746, 750-752, 760-775, 778-797, 807, 881, 884
7	586-593, 595, 798-806, 808-831, 840-847, 855, 859, 865-880, 882-883
8	594, 596-599, 832-838, 850-853, 856-857, 860-864, 890-898, 900-961, 970-986, 988-994

	UPS ZONE						
PRODUCT	2	3	4	5	6	7	8
MTU-130-1D	22.41	24.92	28.05	31.62	36.68	42.06	48.15
MTU-130-2D	23.48	26.34	29.90	33.96	39.72	45.84	52.77
MTU-130-4D	35.08	39.30	44.55	50.54	59.03	68.06	78.28
MTU-130 MANUAL (if ordered separately)	3.38	3.61	3.90	4.22	4.69	5.18	5.74
Floppy Disk Module	11.60	12.96	14.65	16.58	19.31	22.22	25.51
SMARTMODEM	3.43	3.52	3.63	3.75	3.92	4.11	4.32
NEC 8023	5.96	6.63	7.46	8.40	9.73	11.16	12.77
QUME DT8	6.18	6.67	7.28	7.98	8.97	10.02	11.21

NOTES:

Add $5.00 for shipping by other than UPS surface **PLUS** the additional shipping cost for the method requested.

Add $5.00 handling charge for all international shipments and Canadian shipments with a value in excess of $500.00 Canadian.

International shipping will be freight collect by an available carrier to your country. If you specify the shipping method and submit payment, we will honor your request if it is possible.

System Specifications

Standard System Features

Processor

* 6502 processor, 1MHz clock speed, no wait states
* 18 bit address bus
* 16 bit software pseudo processor
* 8 bit data bus
* 2 interrupts provided
* 80K bytes RAM standard
* 48K bytes for user
* 16K bytes 2-port DMA Disk, CODOS
* 16K bytes 2-port DMA display
* Expandable to 256K bytes direct addressing
* Expandable to 1.25M byte bank switching
* 16K bytes of ROM sockets standardd

Floppy Disk Storage

* 8" double density double sided
* 1024K byte formatted per drive
* 1, 2 or 4 drives supported
* 19.6K bytes/sec CODOS sustained transfer rate
* 37.5K bytes/sec special sustained transfer rate
* Exceptional data separator circuit
* DMA operation to 16K on-board memory
* Interrupts possible during read/write
* 3.5" double density 1-side drives available upon request

Video Circuitry

* 480X256 direct screen bit mapped
* 240X256 direct screen bit mapped, 4 level grey
* 1536X1024 indirect screen bit mapped (available std with DATAMOVER)
* 24 lines by 80 characters plus key legends on 25th line
* All characters software reprogrammable
* Composite video output
* Drives standard CCTV monitors

Keyboard

* 96 keys, internally interfaced
* 18 key numeric keypad
* 10 programmable function keys
* 5 key separate cursor cross
* Interrupt, Cold & Warm Reset keys
* Power-on indicator
* All keys software reprogrammable

Input Output Features

* 2 parallel ports
* Each port has 8 lines
* Individual lines may be set for Input or Output
* 4 additional lines with interrupt operation
* +5V, ±12V and RESET at connector
* 36 pin connector
* 1 RS-232 port
* 50 to 19.2K baud, software select
* Interrupt operation
* Full modem interface signals
* 25 Pin connector
* Fiber optic light pen
* Dot level resolution,
* ±2 dot uncertainty
* Digitizing speed 30 - 60 hits/sec
* Light pen wand replacable
* Audio output port
* 8-bit D/A signal generator
* 6 pole low pass filter, 3.7KHz cutoff frequency
* 1 watt power amplifier
* Built-in 3X5" speaker with volume control
* External audio output jack
* Interval timer
* 2 independent timers provided
* 1 microsecond timing resolution
* Can generate interrupts

Internal Expansion Card System

* Rear panel custom connector expansion holes provided with metal covers
* All connectors have gold contacts
* Supports large 11" wide option boards
* 5 backplane board positions:
  - #1 optional expansion
  - #2 optional expansion
  - #3 optional expansion
  - #4 Disk Controller
  - #5 Processor board

Power Supply

* Capable of powering full expansion
* Noise/spike filter on AC power input
* Internal cooling fan standard
* Power ON/OFF switch
* Dual switched AC convenience outlets
* 115/220 Volt AC 50/60 Hz
* Detachable grounded line cord
* Primary AC circuit fused

Prototype Wirewrap Board
EPROM Programmer

Mechanical

* Computer Module — 22"WX 14"DX4.5"H
* Floppy Disk Module — 14.5"WX 16"DX9.5"H
* CRT Module — 15.5"WX11.5"DX 11"H

Optional Expansion

Processors

* MC68000, 8MHz clock speed
* Approx. 1 million instructions/sec
* 32 bit data and address registers
* 20 bit address bus
* 16 bit data bus
* 256K bytes standard RAM
* Expandable to 1MByte direct address
* DMXMON/CODOS system supplied std.
* Two 68000 boards usable together
* Usable with Z-80 board in system

* Z-80A 4Mhz clock speed
* CP/M operating system
* 16 bit address bus
* 8 bit data bus
* 64K bytes standard RAM
* 6502 interaction on disk operations
* Usable with 68000 boards in system

Rigid Disk Storage

* 4" removable cartridge
* 5 Mbytes formatted per drive
* 4 hard disk drives in addition to 4 floppy disk drives
* 30K bytes/sec CODOS sustained transfer rate
* 60K bytes/sec special sustained transfer rate
* Exceptional data separator circuit
* DMA operation to on-board memory
* Processor independent disk transfers

Multi-O Board

* 12-BIT A/D, 8 channels, 70uS/sample
* 12-BIT D/A, 25uS settling to .01%
* PERPETUAL CLOCK/CALENDAR CHIP
* TWO 8-BIT PARALLEL I/O PORTS
* TWO SYNC/ASYNCHRONOUS SERIAL PORTS
* IEEE-488 BUS INTERFACE

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Permit No

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